Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

II.

On a Table of Standard Wave Lengths of the Spectral Lines.[*]

BY HENRY A. ROWLAND.

Presented May 10, 1893.

SOME years since, having made a machine for ruling gratings and discovered the concave grating, which placed in my hands an excellent process for photographing spectra, I applied myself to photograph the solar spectrum. The property of the concave grating, mounted in the method which I use, of producing a normal spectrum gave me the means of adding a scale of wave lengths, and so producing a photographic map of the solar spectrum on a very large scale and of great accuracy. I soon after constructed a very much better ruling engine, which is kept at a uniform temperature in the vault of the new physical laboratory of the Johns Hopkins University, with which I have made very much better gratings. I therefore went over the whole process once more, extending the map to include *B*, and making new negatives of the whole spectrum very much better than the old. This set of ten photographic plates is now familiar to most spectroscopists.

In order to place the scale on the negatives, it was necessary to know the wave lengths of certain standard lines. Of course my first thought was of Angström, whose measurements were the wonder of his time. On trying to place my scale according to his figures, I found it impossible to make them and my photographs agree; and I finally was forced to the conclusion that a new series of standards was needed before I could go further. Here again the concave grating came to my rescue. All the spectra are in focus at once, and relative measures can thus be made at once by micrometric measures of the overlapping spectra. Again, the spectrum is normal, and so a micrometer of very long range could be used.

---

[*] An abstract of this paper has recently appeared in "Astronomy and Astro-Physics," and in the "London Philosophical Magazine."

To obtain the primary standards by means of overlapping spectra, I have used gratings with from 3,000 up to 20,000 lines to the inch, and from 13 to 21½ feet focus. The first series made with the 13-foot grating by Mr. Koyl in 1882 was not found quite accurate enough, and I have since made personally a long series with gratings of 21½ feet focus which is much more accurate. These long focus gratings had from 7,000 to 20,000 lines to the inch, and were ruled on two dividing engines, while the 13-foot one had a less number, possibly 3,000. There are two principal errors to guard against in this method, the first peculiar to the method of coincidences, and the second to any method where gratings are used.* The first is that, where spectra are over each other and the lines therefore often on top of each other, the line of one spectrum may be apparently slightly displaced by the presence of one from another spectrum, although the latter may be almost invisible. The use of proper absorbents obviates this difficulty. The second source of error is more subtle, and arises from the diamond ruling differently on different parts of the grating. It is more apt to occur in concave gratings than plane ones, although few are perfectly free from the error, as it is very difficult to get a diamond to rule a concave grating uniformly. Looking at the grating in spectra of different orders, the grating may appear uniform from end to end in one, and possibly brighter at one end than the other in another spectrum. This gives a chance for any imperfection in the form of the surface of the grating, or any errors in its ruling, or indeed the spherical aberration of the lenses or concave grating, to affect the measurement of relative wave length.† This error I have guarded against by using only uniformly ruled gratings, reversing them, and using a great number of them. I have also used the coincidence of only the lower orders of spectra, such as the 2d, 3d, 4th, 5th, and 6th. Coincidences up to the 12th were, however, observed by Mr. Koyl with the 13-foot concave, and probably have some errors of this nature.

In this way I established about fifteen points in the visible spectrum which served as primary standards. These were so interwoven by the coincidences that I have great confidence in the value of most of them. Indeed, no process of angular measurement could approach the accuracy of this one.

---

* The variation of the dispersion of the air with the thermometer and barometer is probably not worth considering for the visible part of the spectrum, although it might be worth investigating for the two extremities of the spectrum.

† The error of using gratings of variable brightness in different parts, or those with imperfect ruling of any kind, I have constantly guarded against. Such I believe to be the principal causes of the great errors in relative and absolute wave lengths in Vogel's tables, as the gratings he used, made by Wandschaft, were full of errors of all kinds.

Thus, using a line *P* to start with, I determine other groups of lines, *a*′, *b*′, *c*′, *d*′, etc. From these again I find groups, some of which may be the same as the first; then again from these, other groups. The process can be continued further, but we are apt to come back to the same lines again, and we are further limited by the visibility of the lines. Thus the limit of great accuracy by eye observation in either direction is practically 4200 and 7000; although in a dark room, especially in the first spectrum, one can see much further, even beyond the *A* group, although it is difficult to set on the lines, and one is apt to mistake groups of lines for single lines.* When one uses a group as a standard, and one or more of the group is an atmospheric line which varies, the measures will of course vary also, unless the atmospheric line is in the centre of the group. This is a very common source of error, and has caused me much trouble. In a grating with a very bright second spectrum, I have, however, obtained the coincidence of *A* with the region whose wave length is about 5080, and have thus confirmed the value given in my preliminary table, which was obtained by a very long interpolation passing from the first into the second spectrum.

The accuracy of these primary standards can be estimated from the equations given in Table VII. It is there seen that there is scarcely any difference in the different measures as derived from different lines.

It is to be specially noted that the wave length of *P* and the lines directly determined from it have no more weight than any of the others. The table might just as well have been arranged with the *D* line, or any other, first. The true way of discussing the results is to form a series of linear equations, about twenty-six in all, and solve them. This is the method I have used, although I have not discussed them by the method of least squares.†

Some miscellaneous observations not included in the table allowed me to add a few more lines to these primary standards.

Having completed these primary standards, I then observed several hundred standard lines in the visible spectrum, including these primary standards, with a micrometer having a range of five inches, and very accurately made. The spectrum being strictly normal, the readings so made were proportional to the wave length. They could have been used simply to interpolate between the primary standards, but I preferred another method. The readings of the micrometer were made to overlap, so that, by adding a constant to each set, a continuous series could be formed for the whole spectrum which would be proportional to the wave length except for some slight errors due to the working of the apparatus for keeping the focus constant. Making this series coincide with two standards at the ends, the wave lengths of all could be obtained by simply multiplying the whole series by one number and adding a constant. This usually gave the wave lengths of the whole spectrum within 0.1 or 0.2 divisions of Angström. The differences of this series from the primary standards were then plotted, and a smooth curve drawn through the points thus found. The ordinates of this curve then gave the correction to be applied at any point.

---

* In a very bright grating I have faintly seen, and even measured, lines down to wave length 8500. My assistant, Mr. L. E. Jewell, can see far into what is called the ultra violet, even to wave length 3500 or beyond.

† The calculations of this paper have involved about a million figures, of which I have personally written more than half. Hence I am not anxious for more labor of this kind.

It is to be noted that the departure from the normal spectrum was very small, and the correction thus found was very certain. The cause of the departure was not apparent, but may have been the slight tilting of the spectrum, by which it was measured somewhat obliquely at places.

The visible spectrum was thus gone over five or more times in this manner, with several different gratings and in different orders of spectra. The results are given in Table X., Columns *C*, *R*, *p*, *q*, *m*, *O*, *e*, *h*, *i*, etc. The spectrum from the green down to and including *A* was also observed on a large instrument for flat gratings, having lenses six and one half inches in diameter and of eight feet focus. These latter observations are marked *C′*. This region I intend at some future time to observe further.

It was now required to observe the ultra violet to complete the series. For this purpose the coincidences of the 2d, 3d, 4th, 5th, and 6th spectra of a 7000, 21½ feet radius, grating were photographed. My instrument will take in photographic plates twenty inches long, but there will be a slight departure from a normal spectrum in so long a plate. Hence plates ten inches long were mostly used for this special series. Before the camera was placed a revolving plate of metal about three sixteenths of an inch thick, and having a slit in it of the same width.* When the flat side was parallel to the camera plate, a strip of the spectrum three sixteenths of an inch wide fell on the plate. When turned ninety degrees, the plate shielded this portion and exposed the rest. Using absorbents, it was thus possible to photograph a strip of say the 4th spectrum between two strips of the 5th. This arrangement is better than having only two edges come together. To correct any movement of the apparatus during the time of exposure, I expose on one spectrum, then on the other, and back again on the first.

---

* This is described in the Johns Hopkins Circular of May, 1889, by Dr. Ames.

Placing the negatives so obtained on a dividing engine with a microscope of very low power and a tightly stretched cross hair, the coincidence of the two spectra can be measured. Owing to the large scale of the photographs, — about that of Angström, — an ordinary dividing engine having errors not greater than $\frac{1}{1000}$ inch can be used, but the negatives should be gone over at least twice, reversing them end for end. Two screws were used in the engine and finally another complete machine was constructed, giving wave lengths direct with only a slight correction. For determining the wave length of metallic lines, the same process can be used with wonderful accuracy.

The results are given in the columns marked *Pl.* with the number of the plates. The accuracy is very remarkable, and I think the figures establish the assertion that the coincidence of solar and metallic lines can be determined with a probable error of one part in 500,000 by only one observation.

This process not only gave me measures of the ultra violet, but also new observations of the visible spectrum. So far in my work on these coincidences, I have only used erythrosin plates going a little below *D*; but cyanine plates might be used to *B*, or even in the ultra red, as Trowbridge has recently shown. One plate, No. 20, however, connects wave lengths 6400 and 3200.

Thus I have constructed a table of about one thousand lines, more or less, which are intertwined with each other in an immense number of ways. They have been tested in every way I can think of during eight or nine years, and have stood all the tests; and I think I can present the results to the world with confidence that the results of the relative measures will never be altered very much. I believe that no systematic error in the relative wave lengths of more than about ± .01 exists anywhere except in the red end as we approach *A*. Possibly ± .03, or even less, might cover that region.

The relative measures having thus been obtained, we have means in the concave grating of obtaining the wave lengths of the lines of metals to a degree of accuracy hitherto unknown, and thus of solving the great problem of the mathematical distribution of these lines.

But for the comparison of spectra, as measured by different observers, some absolute scale is needed. Hitherto Angström has been used. But it is now very well known that his standard measure was wrong. As his relative measures are also very wrong, I have concluded that the time has come to change not only the relative measures, but the absolute also. To this end Dr. Louis Bell worked in my laboratory for several years with the best apparatus of modern science, using two glass and two speculum metal gratings, ruled on two dividing engines with four varieties of spacing, three of which were incommensurable or nearly so, with two spectrometers of entirely different form, with a variety of standard bars compared in this country and in Europe, and with a special comparator made for the measure of gratings. His result agrees very well with the next best determination, that of Mr. C. S. Peirce of the U. S. Coast Survey. His final result agrees within 1 in 50,000 with his preliminary value.* This most recent value, combined with those of Pierce, Müller and Kempf, Kurlbaum and Angström, I have adopted to reduce my final results to, although the calculations are made according to Bell's preliminary value. See Appendix A.

But it rests with scientific men at large to adopt some absolute standard. The absolute standard is, of course, not so important as the relative, and possibly the average of Angström might be adopted. But for myself I do not believe in continuing an error of this sort indefinitely. All the results obtained before the concave grating came into use were so imperfect, that they must be replaced by others very soon. With a good concave grating, one man in a few years could obtain the wave lengths of the elements with far greater accuracy than now known.

As an aid to this work, I have constructed the table of wave lengths given in this paper, which have already been adopted by the British Association and by the most noted writers of Germany and other countries, and sincerely hope that it will aid in the work of making the wave length of a spectrum line a definite quantity within a few hundredths of a division of Angström.

ABSOLUTE WAVE LENGTH OF *D*.

The following is an estimate of the absolute wave length of the *D* line from the best determinations. First, I shall recalculate the portion of Dr. Bell's paper† in which the calibration of the grating space is taken into account. The method of correction is founded on the principle that a linear error in the spaces only affects the focal length, and not the angle, and that small portions which have an error, and thus throw the light far to one side, should be rejected. The corrections Dr. Bell has used seem to me very proper, except to grating III., which appears to me to be twice too great. I find the following:—

---

* American Journal of Science, 1887.

† American Journal of Science, 1888.

Grating.	*D.*	Correction.	Final Values.
I.	5896.20	—.02	5896.18
II.	5896.14	+.09	5896.23
III.	5896.28	—.06	5896.22
IV.	5896.14	+.03	5896.17

Mean value, 5896.20.

This is very nearly the value given by Dr. Bell.

The determination of Mr. C. S. Peirce of the U. S. Coast Survey is certainly a very accurate one. Dr. Bell and myself have made some attempts to calibrate his gratings, which he sent to us for the purpose, and to correct for the scale used by him. There is great uncertainty in this process, as we had only a portion of the necessary data. The correction of his scale was also uncertain, because the glass scales used by him may have changed since he used them, in the manner thermometer bulbs are known to change. Correcting, then, only for the error of ruling in the gratings, we have:

Peirce's value	5896.27
Correction *	—.07
	5896.20

The correction for the scale would be about as much more in the same direction, provided the glass scales had not changed. But it is too uncertain to be used, although I have applied it in my preliminary paper.

Kurlbaum's result, made with two good modern gratings, has the defect that the gratings were 42 and 43 mm. broad, quantities which it is impossible to compare accurately with a meter. His small objectives, one inch in diameter, could not take in light from the whole grating, and so the grating space was not determined from the portion of the grating used. The spectrometer was poor, and the errors of the grating undetermined.

Müller and Kempf used four gratings, evidently of very poor quality, as they give results which differ 1 in 10,000.

The result of Angström was a marvel at the time, but the Nobert gratings used by him would now be considered very poor. Taking Thalen's correction for error of scale, we have for the mean of the *E* lines 5269.80, which gives, by my table of relative wave lengths, $D = 5895.81$. It is rather disagreeable to estimate the relative accuracy of observations made by different observers and in different countries, but in the interest of scientific progress I have attempted it, as follows: —

---

* Bell, American Journal of Science, May, 1888, p. 365.

		Wt.
Angström	5895.81	1
Müller and Kempf .	5896.25	2
Kurlbaum	5895.90	2
Peirce	5896.20	5
Bell	5896.20	10

Mean, 5896.156 in air at 20° and 760 mm. pressure.

This must be very nearly right, and I believe the wave length to be as well determined as the length of most standard bars. Indeed, further discussion of the question would involve a very elaborate discussion of standard meters, a question involving endless dispute. I think we may say that the above result is within 1 in 100,000 of the correct value, which is very nearly the limit of accuracy of linear measurements. This should be so, as the probable error of the angular measures affects the wave length only to 1 in 2,000,000,* and hence nearly the whole accuracy rests on the linear measures.

RÉSUMÉ OF PROCESS FOR OBTAINING RELATIVE WAVE LENGTHS.

1. Determination of about 20 lines in the visible spectrum by coincidences by Koyl.†

2. Determination of about 15 lines in the visible spectrum by coincidences by Rowland, using several gratings of 21½ feet focus.

3. Interpolation by direct eye observations with concave gratings of 21½ feet focus and micrometer of 5 inches range and of almost perfect accuracy.

4. Interpolation by means of flat gratings.

5. Measurement of photographic plates from 10 to 19 inches long, having two or three portions of the spectrum in different orders on them, thus connecting the ultra violet and blue with the visible spectrum. The fact that nearly the same values are obtained for the violet and ultra violet by use of different parts of the visible spectrum proves the accuracy of the latter.

6. Measurement of photographic plates having the solar visible spectrum in coincidence with the metal lines of different orders of spectra. The fact that the

---

* Is not a grating and spectrometer thus the best standard of length, and almost independent of the temperature? Gratings of 10 cm. length can now be ruled on my new engine with almost perfect accuracy, as seen in the calibration of Grating IV. in Dr. Bell's paper, and it seems to me the time has come for their practical use.

† These observations of Mr. Koyl were finally given no weight, on account of the inferior apparatus used. They serve a useful purpose, however, as checks on the other work.

wave lengths of the metal lines are very nearly the same as obtained from any portion of the visible or ultra violet spectrum proves the accuracy of the latter, as well as that of the metallic wave lengths.

7. Measurement of plates having metallic spectra of different orders.

ADVANTAGES OF THE PROCESS.

The only other process of obtaining relative wave lengths is by means of angular measures. Supposing the angle to be about 45°, an error of $1''$ will make an error of about 1 in 200,000 in the sine of the angle. When one considers the changes of temperature and barometer measuring on one line and then another, together with the errors of graduation, it would be a difficult matter to measure this angle to $2''$, making an error of 1 in 100,000, or about $\frac{1}{20}$ division of Angström.

Looking over the observations of principal standards made under the direction of Professor Vogel in Potsdam, with very poor gratings but an excellent spectrometer, we find the average probable error to be about $\pm\frac{1}{150000}$ of the wave length, which is not far from the other estimate. This does not include *constant* errors, and I believe the probable error to be really greater than this.

The method of coincidences by the concave grating gives far superior results. The distance to be measured is very small, and the equivalent focal length of a telescope to correspond would be very great ($21\frac{1}{2}$ feet). Furthermore, all changes of barometer and thermometer are eliminated at once, except the small effect on the dispersion of the air, which, when known, can be corrected for. It is not to be wondered at that this method is far superior to the former. The probable error is, indeed, reduced to $\pm\frac{1}{1000000}$, or even less for the best lines. Where the interpolation can be made on photographs, this probable error is scarcely increased at all; but even taking it at twice the above estimate, the method even then remains from three to five times as accurate as that of angular measurement. Indeed, the impression made on my mind in looking over Vogel's Potsdam observations is, that my tables and process are ten times as accurate as theirs; and I think any careful student of both processes will come to a similar conclusion.

The wonderful result that can be obtained by the measurement of photographs on the new micrometer, which can measure plates over twenty inches long, is partly seen in the table. Where the distance is only a few inches, the wave length of a series of lines can be measured with a probable error of less than $\frac{1}{100}$ of a division of Angström. Indeed, a series would determine any line so that the probable error would be even ±.0000001 of the whole. This would detect a motion in the line of sight of ±140 feet per second!

From the tests I have made on my standards, I am led to believe that down to wave length 7000, a correction not exceeding ±.01 division of Angström (1 part in 500,000), properly distributed, would reduce every part to perfect relative accuracy.

To ascend to the next degree of accuracy would need many small corrections which would scarcely pay. It is reasonable to assume that a higher degree of accuracy will not be needed for twenty-five years, as the present degree is sufficient to distinguish the lines of the different elements from one another in all cases that I have yet tried.

DETAILS OF WORK.

To reduce all the observations in a given region to one line, relative observations extending a short distance either side of the standard region are necessary. Thus the mean of 4215 and 4222 can be taken as the standard, and, if only one is observed, it can be reduced to the standard by a correction +3.358 or —3.358. But it is not necessary to take the mean of the lines as a standard, as any one of them may be so taken, or even any other point where there is no line, as the point is only to be used in the mathematical work, and finally disappears altogether.

Table II. gives results of this nature. The letters at the top of each series, *e*, *g*, *h*, *j*, etc., are the arbitrary names of the standards. The first columns refer to the series of observations, "Co." being observations made at the time of measuring the coincidences; Plate 9, 10, etc., refer to photographic plates; *C*, *R*, etc., refer to the series as given in the final table, although they may differ very slightly from the latter, as the final table contains slight corrections. Figures in parentheses are the number of readings. The photographs were usually measured from two to six times.

Table III. gives the first series of observations made in 1884 with a 21½ foot concave, 14,436 lines to the inch. The numbers taken for the standards are only preliminary, and agree as nearly as practicable with my Table of Preliminary Standards. As only *differences* are finally used, they are sufficiently near. The fractions give the order of the spectra observed.

Thus, the first observation on *h* and *t* is worked up as follows:—

	4691.590	7027.778
Correction to standard	—.626	+2.785
	4690.964	7030.563

4691.590	4690.326	7027.778
−.626	+.626	+2.785
4690.964	4690.952	7030.563

4691.590	7040.092
−.626	−9.547
4690.964	7030.545

Weight.	*h*.	*t*.
1	4690.964	7030.563
2	4690.958	7030.563
2	4690.964	7030.545
	4690.962	7030.556

The equation $3h - 2t = 11.774$ then readily follows.

Tables IV. and V. are from a 21½ foot concave with 7218 lines to the inch, used on both sides, and thus equivalent to two gratings used on one side only. I have not yet determined theoretically whether the minor errors are perfectly neutralized in this manner; but it would evidently have a tendency in this direction.

The photographic coincidences are given in the main table (X.), as not only the standards are compared by this process, but whole regions are photographed side by side. Both a 10,000 and a 20,000 concave were used for this work.

Table VI. gives the collection of the equations relating to the visible spectrum, the final results being given in Table VII.

The proper method of treating these twenty-six equations would be by the method of least squares. But it would be so long and tedious, and so liable to mistake, that I have adopted the method of starting at one point, and going forward until all the equations are reached. Thus (Table VII.), starting with an assumed value of *e*, we can calculate *p*, *n*, *l*, *k*, *j*, *o*, *t*.

Using the eight values thus found once more, from *p* we have *g*, *k*, *l*; from *n* we have *h*, *t*, *g*; with similar results for the others. Collecting, we then have *e*, *f*, *g*, *h*, *j*, *k*, *l*, *n*, *o*, *p*, *q*, *t*. Using these once more, we have values of all the standards. We could do this any number of times, keeping the proper weights; but I thought this number was sufficient. The second calculation is done in the same manner, starting from *o*, however, and is given in Table VIII.

The results of the two calculations are give in Table IX. Taking the mean and adding the results of local micrometer measurement, we obtain the column marked "Relative Wave Lengths."

Reducing these values by 1 part in 200,000, we make them agree with the absolute value of the standard as before agreed upon. Thus the column of standards is obtained for use in the visible spectrum.

For ordinary interpolation with the short and imperfect micrometers generally used, and working with a flat grating and a spectrum not normal, the standards would be too far apart. But with such a long and perfect micrometer as I use, and working with the normal spectrum of a concave grating, they are entirely sufficient. However, I have filled in the interval from 7030 to 7621 by some extra sub-standards at 7230.

The micrometer for eye observations has a range of five inches, and the machine for measuring photographs of more than twenty inches, both with practically perfect screws made by my process. The eye observations are not an interpolation, in the ordinary sense, between the standards, but the whole series is continuous, the micrometer observations overlapping so that they join together to any length desired. By measuring from the *D* line in one spectrum to the *D* line in the next, and including the overlapping spectra, no further standards would be necessary, as all the lines of the spectrum would be determined at once, knowing the wave length of the *D* line. But I usually plotted the difference of the standards from the micrometer determination, usually amounting to less than one or two tenths of a division of Angström, and so corrected the whole series to the standards. Sometimes two, or even three, overlapping spectra were measured at once.

To make Table X., the following process was used.

1st. From all the observations at my disposal, I determined a few more lines around the main standards, and put them in the second column, marked St., so that I should have a greater number of points to draw my curve through.

2d. I then put down a few observations which were made by measuring overlapping spectra.

3d. Then the main eye observations were put down as follows: —

p extending from 4071 to 7040, 2d spectrum, 14,436 grating.
q “ “ 4999 to 7035, “ “ “ “
O “ “ 4859 to 7040, “ “ “ “
c “ “ 4859 to 6079 (fragmentary).
C “ “ 6855 to 6909, 2d spectrum, 14,436 grating.
R “ “ 5162 to 7201, “ “ “ “
h “ “ 5742 to 7628, 1st spectrum, 14,436 grating.
i “ “ 6065 to 7671, “ “ “ “
C′ “ “ 6855 to 7714, plane grating.
R′ “ “ 5139 to 5296, 2d spectrum, 14,436 grating.
t “ “ 6499 to 6929, “ “ “ “
a “ “ 6278 to 6322, “ “ “ “
E “ “ 4048 to 4824, “ “ “ “

4th. The series of photographs containing coincident spectra, mostly on plates so short as to make the spectra nearly normal, were now introduced. The plates were numbered from 1 to 20, Nos. 7 and 19 being rejected because imperfect.

This series of plates were obtained by photographing a narrow strip of one spectrum between two strips of another, the overlapping spectra being separated by absorption. In order to eliminate any change in the apparatus during the exposure, the latter was divided into three parts, the first and third being given to the same spectrum.

This series of plates gives me a continuous series of photographs from wave length 7200 to the extremity of the ultra violet spectrum, each part being interwoven with one or two other parts of the spectrum. Thus, wave length 3900 comes from 5200 and 5850 with only a slight difference in values. There is scarcely any difference in any wave length as derived from any portion of the spectrum; thus proving the accuracy of the whole table. The description of the plates is as follows.

PHOTOGRAPHIC COINCIDENCES.

Concave Grating 10,000 Lines to the Inch.

Spectra.	Plate.		Standard.
$\frac{3}{4}$	1	4407 to 4643 and 3331 to 3486	*f*, *g*
"	2	4637 " 4890 " 3478 " 3667	*h*, *j*
"	3	4823 " 5068 " 3612 " 3805	*j*, *k*
"	4	4919 " 5133 " 3683 " 3875	*j*, *k*
"	5	5050 " 5288 " 3780 " 4005	*k*, *l*
"	6	5097 " 5333 " 3821 " 4157	*k*, *l*
"	7		
"	8	5242 " 5477 " 3937 " 4121	*l*, *m*
"	9	5405 " 5662 " 4073 " 4222	*m*, *n*, *e*
"	10	5582 " 5816 " 4293 " 4376	*n*, *f*
"	11	5782 " 5934 " 4343 " 4447	*o*, *f*
"	12	4157 " 4267 " 3129 " 3218	*e*
"	13	4157 " 4325 " 3094 " 3246	*e*
"	14	3218 " 3318	
"	15	4391 " 4643 " 3292 " 3478	*f*, *g*
$\frac{4}{6}$	16	5788 " 5977 " 3864 " 3977	*o*
"	17	5788 " 5977 " 3864 " 3984	*o*
"	18	5715 " 5977 " 3875 " 3977	*o*
"	19		
$\frac{1}{2}$	20	5853 " 6569 " 3024 " 3267	*o*, *p*, *q*

Plates 7, 14, and 19 were imperfect, owing to clouds passing over the sun, although a part (3218 to 3318) of Plate 14 was used for interpolation, as observations were scanty in that region.

It is seen that some of the plates have only one standard upon them. With a plane grating it would be impossible to work them up, but with the normal spectrum produced by the concave grating only one is necessary, as the multiplier to reduce readings to wave lengths is nearly a constant. In working up a whole series of plates, there is no trouble in giving a proper value to the constant for any plate in the series which has only one standard.

Plate 17 was measured twice by two dividing engines, and as it was a specially good plate, each measure was given a weight equal to one of the other plates. The principal error to be feared in these plates is a displacement of the instrument between the time of the exposure on the two spectra. This was guarded against by the method above described. In Plates 17 and 20 there was a portion of the plate on which both the spectra fell all the time, and thus gave a test of the displacement. This was found to be zero. The other plates overlap so much that there are generally two or more determinations of each line. A comparison of these values shows little or any systematic variation in the different plates exceeding $\frac{1}{100}$ division of Angström. Plates 16, 17, 18, and 5, 6, 8, all give the region 3900 as derived from 5200 and 5850, and thus give a test of the relative accuracy of these latter regions. It is seen that the two results of the region 3900 differ by about .015 division of Angström. Were the wave lengths of the region 5170 to 5270 to be increased by .020 the discrepancy would cease. The amount of this quantity seems rather large to be accounted for by any displacement of the spectra on the plates, but still this may be the cause. Again, it is possible that different gratings may give this difference of wave length from the cause I have mentioned above. This cause, as I have shown, exists in the same degree in plane gratings as in concave. I have not attempted to correct it in this case, but have simply taken the mean of the two values for the region 3900, and so distributed the error. This is the greatest discrepancy I have found in the results, except in the extreme red.

Thus the region 3100 to 3200, a portion for which Plate 20 is to be relied upon, gives the wave length of the ultra violet .01 division of Angström higher from the region 4200 than from 6300. As the discrepancies in this region before the invention of the concave grating were often a whole division of Angström, I have regarded this result as satisfactory. Indeed, until we are able to make all sorts of corrections due to the change in the index of refraction of the air with the barometer and thermometer, it seems to me useless to attempt further accuracy.

With the advent of photographic plates into the table, especially the longer ones required for metallic spectra, it becomes necessary to correct them for the departure from the normal spectrum due to the use of long plates. The plates in the box are bent to the arc of a circle of radius r. When afterwards straightened we measure the distance by a linear dividing engine. Hence, what we measure is the arc with radius r. Let α and β be the angles of incidence and diffraction from the grating. We have then to express β in terms of δ. Let λ be the wave length, and n and N the number of lines on the grating to 1 mm. and the order of the spectrum respecttively. Then

$$\lambda = \frac{1}{nN} (\sin \alpha + \sin \beta) ;$$

$$\sin \beta = \frac{2r}{R} \sin \frac{\delta}{2} \cos \left(\gamma + \beta - \frac{\delta}{2}\right).$$

In these formulæ α is the angle to the centre of the photographic plate, and β and δ are also measured from the centre. γ is the angle between the radius from the centre of the photographic plate and the line drawn from that point to the centre of the grating. When properly adjusted, γ will be zero. Also we make $2r = R$, to obtain perfect focus throughout. So that

$$\lambda = \frac{1}{nN} \left(\sin \alpha + \sin \frac{\delta}{2}\right).$$

Calling λ_0 the wave length at the centre of the plate, we have approximately

$$\lambda - \lambda_0 = \frac{\delta}{2nN} - \frac{n^2N^2}{6} (\lambda - \lambda_0)^3 + \text{etc.}$$

The first quantity, $\frac{\delta}{2nN}$, is the value of $\lambda - \lambda_0$, assuming the spectrum to be normal. The last term is the required correction expressed in terms of the provisional wave length. The correction in actual practice has been made from a plot of the correction on a large scale, and never amounted to more than a few hundredths of a division of Angström, even for the longest plate.

In two or three plates the camera was displaced, so that γ had a value. In such cases no attempt was made to measure γ, but the plates were only used for local interpolation by drawing a curve through certain points used as substandards.

These substandards were principally used for working up the last set of photographic plates containing the solar spectrum and the metal spectra of the same or higher orders, or both. Some of them contained three metallic spectra.

Thus the region 3900 in the solar spectrum has been obtained from both wave lengths 5200 and 5850. The mean of these gave values of the substandards for working up the plates taken at this point, and containing also metallic lines at 2700.

Again, the boron lines at 2496 and 2497 have been obtained from the regions 4800, 3200, and 3600. The mean values give substandards for working up the metallic spectra of that region. Also the near coincidence in the values of the wave lengths of these lines indicate the relative accuracy of the regions 2496, 3200, 3600, and 4800.

The use of these substandards is as follows. The photographic plates, mostly 19 inches long, were measured mostly on a machine giving wave lengths direct. The difference of the results from the substandards were then plotted on a paper having the curve of correction for length upon it in such a way that the final marks should theoretically be a straight line. This was actually the case in all but a few plates, in which the camera was displaced. A straight line was then passed through all the marks as nearly as may be, and the correction taken off. This correction could thus be obtained to $\frac{1}{1000}$ division of Angström, and amounted to only a few hundredths of a division at most. Possibly $\frac{1}{10}$ division of Angström was the greatest correction required for length.

In this way each plate represents the average of all the wave length determinations throughout its extent, and will not admit of any correction save a linear one, should such ever be required in working over the table again.

In every plate having a solar and metallic spectrum upon it, there is often—indeed always—a slight displacement. This is due either to some slight displacement of the apparatus in changing from one spectrum to the other, or to the fact that the solar and the electric light pass through the slit and fall on the grating differently. In all cases an attempt was made to eliminate it by exposing on the solar spectrum, both before and after the arc, but there still remained a displacement of $\frac{1}{100}$ to $\frac{2}{100}$ division of Angström, which was determined and corrected for by measuring the difference between the metallic and coinciding solar lines, selecting a great number of them, if possible.

The changes from sun to arc light are much more extensive than from one order of solar spectrum to another. In two cases I have tested the latter, and found no displacement, and have no fear that it exists in the others.

In working up the plates, I have started at the plates whose centre is at wave length 4600, and proceeded either way from that point. For this purpose I have used the plates originally obtained for metallic spectra, generally using the lines due to the impurities. The method, I believe, is obvious from the table. For a long region no substandards are necessary, but are used whenever they become so.

TABLE I.

PRELIMINARY OBSERVATIONS BY MR. KOYLE,

Made at Baltimore in 1882 and 1883.

Wt.	Spectra.	From 5624.23 and 5624.76.	From 4824.34.	*From Table.	Wt.	Spectra.	From 5624.23 and 5624.76.	From 4824 34.	From 6563 04.	From 5162.51.	From Table.
2	$\frac{6}{8}$	4215.67		.67	1		5624.23				.25
1	$\frac{10}{13}$	4325.92		.94	1		5624.76				.77
1	$\frac{7}{9}$	4376.06		.10	1	$\frac{5}{6}$			5788.11		.14
1	$\frac{8}{10}$	4497.06		.05					5791.21		.21
1		4501.44		.44	2	$\frac{9}{10}$			5890.19		.18
1	$\frac{10}{12}$	4691.64		.58					5893.07		.10
4	$\frac{6}{7}$	4824.34		.33	2	$\frac{9}{10}$			5896.17		.15
3	$\frac{7}{8}$	4919.15		.18	4	$\frac{9}{10}$			5914.36		.38
2		4920.70		.68	2	$\frac{8}{10}$		6024.31			.28
2		4924.13		.11				6027.31			.27
1	$\frac{8}{9}$	4994.39		.32	1	$\frac{9}{10}$	6246.58				.53
3		5006.31		.30	3	$\frac{8}{9}$	6322.91				.91
3	$\frac{9}{10}$	5060.22		.25	6	$\frac{7}{8}$	6431.09				.06
1		5109.82		.82	3	$\frac{6}{7}$	6563.04				.05
2	$\frac{10}{11}$	5110.58		.57	2	$\frac{5}{6}$	6750.41				.41
1		5162.51		.45	1	$\frac{5}{6}$	6752.92				.96
1	$\frac{9}{10}$		5353.64	.59	1					6884.11	.08
1			5361.83	.81							

* This column has been added from the final table of standards, because no use was made of Mr. Koyle's observations on account of the inferior grating he used. The comparison is thus of special interest. The differences are probably due to want of precautions which were finally adopted.

TABLE II.

RELATIVE MEASURES AROUND STANDARDS.

[*The figures in parentheses are the number of readings.*]

e.

	4215	4222
Co. (8)	0	6.720
" (8)	0	6.714
" Phot.	0	6.723
" (8)	0	6.717
" (8)	0	6.710
" (4)	0	6.715
Mean	0	6.7166
Plate 9	0	6.724
" 10	0	6.724
" 12	0	6.705
" 13	0	6.707
" 19	0	6.725
Mean	0	6.717
Correction to standard .	+3.358	−3.358

g.

		4494	4497	4501	4508
Co. (4)	Wt. 1	−2.308	0	4.398	11.415
" (6)	" 1	−2.313	0	4.397	11.412
" (6)	" 1	−2.317	0	4.400	11.409
" (4)	" 1	−2.332	0	4.401	11.418
	Mean	−2.317	0	4.399	11.413
Plate 15		−2.321	0		
" 1		−2.328	0	4.392	11.410
	Mean	−2.324	0	4.392	11.410
Give first three times weight of second mean		−2.319	0	4.397	11.412
Correction to mean . .		5.270	5.270	5.270	5.270
Correction to standard .		+7.589	+5.270	+0.873	−6.142

h.

	4690	4691	
Co. (8)	0	1.257	
" (6)	0	1.245	
" (4)	0	1.249	
" (2)	0	1.254	
" (6)	0	1.251	
Mean	0	1.251	
Plate 2	0	1.254	3.925
Correction to standard .	+ 0.626	−.626	

j.

	4903	4924	4924
Co. (4)	0	20.638	21.474
" (4)	0	20.632	21.476
Plate (3)	0	20.609	21.466
Mean	0	20.626	21.472
Correction to standard .	+14.033	−6.593	−7.439

k.

	5060	5064	5068
Co. (8)	0	4.585	8.686
Plate 3	0	4.586	8.698
" 4	0	4.588	8.706
" 5	0	4.578	8.695
Mean	0	4.584	8.696
Correction to standard .	+4.427	−0.157	−4.269

l.

	5269
Co. (6) . .	.783
" (4) . .	.781
" (6) . .	.788
" Phot. .	.780
Mean	.783

	5270
C	.756
R	.773
p	.757
m	.780
d	.768
c	.782
C	.780
S	.780
R'	.774
Plate 9	.786
" 5	.781
" 6	.792
" 7	.798
" 8	.777
Mean	.779

	.783
	.777
Mean	2) .780
Correction to standard	±.390

n.

Co.	Weight	2	.500
"	"	2	.515
"	"	1	.516
"	"	2	.512
"	"	1	.500
"	"	1	.517
"	"	1	.500
"	"	1	.523
	Mean		.510

50 observations in all.

	5624	5624
Correction to standard	+.255	−.255

o.

	5862	5890	5896	5914
Co. (4)		0	5.966	24.198
" (4)		0	5.973	24.192
" (6)		0	5.961	24.199
" Phot.		0	5.975	24.203
Mean		0	5.969	24.198
C	−27.593	0	5.981	24.192
R	−27.599	0	5.976	24.222
p	−27.622	0	5.971	24.186
h	−27.605	0	5.954	24.204
Plate 19	−27.582	0	5.990	24.222
" 11	−27.600	0	5.979	24.201
" 16	−27.607	0	5.974	24.200
" 17	−27.612	0	5.976	24.207
Mean	−27.602	0	5.975	24.204
Taking this series with twice the weight of the other, we have	−27.602	0	5.973	24.202
Add	.643	.643	.643	.643
Correction to standard	−28.245	.643	−5.330	−23.559

p.

	6246	6318	6322
Co. (4)	−71.703	0	4.674
" (8)		0	4.674
C	−71.719	0	4.665
R	−71.711	0	4.672
p	−71.704	0	4.667
h		0	4.688
o	−71.718	0	4.660
Mean	−71.711	0	4.671
	2.336	2.336	2.336
Correction to standard	+74.047	+2.336	−2.335

q.

	6563	6564	6569
Co.	0		6.405
C	0	1.323	6.423
R	0	1.331	6.422
p	0		6.415
h	0	1.354	6.400
o	0	1.373	
b	0		6.405
Mean	0	1.345	6.412
Correction to standard	+3.206	+1.861	−3.206

t.

	7023	**7027**	**7040**
Co. (2)	0	3.982	16.294
" (4)	0	3.982	16.292
" (6)	0	3.995	16.330
" (4)	0	3.971	16.290
Mean	0	3.984	16.306
C	0	3.998	16.332
R	0	3.980	16.316
h	0	3.939	16.300
C'	0	3.961	16.301
Mean	0	·3.970	16.312
General mean	0	3.977	16.309
	6.762	6.762	6.762
Correction to standard	+6.762	+2.785	−9.547

TABLE III.

SIX-INCH CONCAVE GRATING.

Grating 14,436 lines to the inch, and 21½ feet radius.

Observations made in 1884 by Rowland.

Orders of Spectrum.

(1) No. of readings.
2 ob. 4691.590 7027.778
⅔ 2 ob. 4691.590 4690.326 7027.778
4 ob. 4691.590 7040.092
∴ $h = 4690.962$ $t = 7030.556$
Hence $3h - 2t = 11.774$

(2) ⅔ 4 ob. 4215.656 6322.906
Hence $3e - 2p = 15.900$

(3) ⅔ 10 ob. 4376.101 6563.042
Hence $2q - 3f = 4.193$

(4) ⅔ 10 ob. 4376.104 6563.042 6564.423
Hence $2q - 3f = 4.220$

(5) ⅔ 4 ob. 6884.082 4590.109 4588.364

(6) ⅔ 10 ob. 6322.879 4215.655
Hence $3e - 2p = 15.951$

(7) ⅔ 7 ob. 6322.879 4215.651
Hence $3e - 2p = 15.939$

(8) $\frac{2}{3}$ 4 ob. 4501.442 6750.391
Hence $3g - 2s = 6.163$

(9) $\frac{2}{3}$ 8 ob. 4508.445 4504.991 4502.385 4501.442 6750.405
Hence $3g - 2s = 6.117$

(10) $\frac{2}{3}$ 10 ob. 4501.439 6750.403
Hence $3g - 2s = 6.130$

(11) $\frac{2}{3}$ 4 ob.
4222.366 4215.670 6322.902 6318.250 6285.340 6252.782 6246.535
Hence $3e - 2p = 15.898$

(12) $\frac{2}{3}$ 4 ob. 4691.588 7027.782
Hence $3h - 2t = 11.752$

(13) $\frac{2}{3}$ 9 ob. 6439.310 4293.240 (G)

(14) $\frac{2}{3}$ 6 ob. 4691.588 7035.164 7027.771 7016.749 7016.364
Hence $3h - 2t = 11.774$

(15) $\frac{2}{3}$ 6 ob. 4501.426 6750.406
Hence $3g - 2s = 6.085$

(16) $\frac{2}{3}$ 6 ob. 6439.300 6431.070 4293.232

(17) $\frac{2}{3}$ 4 ob. 4823.699 4824.312 7233.927 7233.166 7240.972

Collecting, we have for the relations established by this grating the following equations: —

8 ob.	$3h - 2t = 11.774$	4 ob.	$3e - 2p = 15.900$
4 ob.	$3h - 2t = 11.752$	10 ob.	$3e - 2p = 15.951$
6 ob.	$3h - 2t = 11.774$	7 ob.	$3e - 2p = 15.939$
		4 ob.	$3e - 2p = 15.898$
Mean	$3h - 2t = 11.769$		$3e - 2p = 15.931$
10 ob.	$2q - 3f = 4.193$	4 ob.	$3g - 2s = 6.163$
10 ob.	$2q - 3f = 4.220$	8 ob.	$3g - 2s = 6.117$
		10 ob.	$3g - 2s = 6.130$
		6 ob.	$3g - 2s = 6.085$
Mean	$2q - 3f = 4.207$		$3g - 2s = 6.121$

4 ob.	6884.082	4590.109	4588.364
	28	17	17
	.110	.126	.381

9 ob.	6439.310	4293.240
	7	5
	.317	.245

6 ob.	6439.300	6431.072	4293.232
	20	20	13
	.320	.092	.245

4 ob.	4823.699	4824.312	7233.927	7233.166	7240.972
	685	312	10	10	10
	.014	.000	.917	.156	.962

TABLE IV.

SIX-INCH CONCAVE GRATING, 21½ FEET RADIUS.

7,218 lines to inch. — November, 1884.

SERIES I. — GRATING USED DIRECT.

Observed by Rowland.

(1) $\frac{5}{6}$ 8 ob. 4691.584 4690.328 5624.777 5624.265
Hence $6h - 5n = 23.137$

(2) $\frac{4}{5}$ 6 ob. 4508.455 4501.440 5624.763 5624.248 4497.043 4494.730
Hence $5g - 4n = 13.550$

(3) $\frac{3}{4}$ 8 ob. 4222.382 5624.765 5624.260 4215.661
Hence $4e - 3n = 2.552$

(4) $\frac{3}{4}$ 8 ob. 4222.380 5624.765 5624.268 4215.665
Hence $4e - 3n = 2.538$

(5) $\frac{3}{4}$ 4 ob. 6013.770 4508.473 6003.264 4501.444 4497.050 4494.718
Hence $3\,(6003) - 4g = 16.275$

(6) $\begin{smallmatrix}4\\5\\6\end{smallmatrix}$ 8 ob.
4508.449 5405.977 4501.440 6750.394 5397.338 4497.040 4494.723
Hence $6g - 5m = 5.581$; $5m - 4s = 6.709$; $6g - 4s = 12.290$

(7) $\frac{5}{6}$ 8 ob. 6322.910 5270.499
Hence $5p - 6l = -17.779$

(8) $\frac{5}{6}$ 8 ob. 6322.910 5270.499
Hence $5p - 6l = -17.779$

(9) $\frac{5}{6}$ 4 ob. 6322.910 5270.501
Hence $5p - 6l = -17.791$

(10) $\frac{5}{\frac{6}{7}}$ 4 ob. 5270.500 6322.911 4508.458 4501.454
Hence $5p - 6l = -17.780$; $5p - 7g = 86.633$; $6l - 7g = 104.413$

(11) $\frac{3}{\frac{4}{5}}$ 6 ob.

The fifth spectrum was very difficult to see, and hence the observations on *e* are poor.

7040.052 4222.390 7027.717 5270.500 5269.718 4215.681 7023.722
Hence $3t - 4l = 11.055$; $5e - 4l = 14.739$; $5e - 3t = 3.684$

(12) $\frac{4}{\frac{5}{6}}$ 4 ob. 7040.072 4691.592 5624.765 7027.750 7023.782 5624.267
Hence $4t - 5n = -.440$; $5n - 6h = -23.216$; $4t - 6h = -23.656$

(13) $\frac{4}{5}$ 4 ob. Poor series.
5896.166 4691.585 5862.590
Hence $4o - 5h = 108.549$

(14) $\frac{3}{\frac{4}{5}}$ 2 ob. Difficult to see.
7040.061 4222.378 5270.499 5269.724 4215.710 7027.749 7023.767
Hence $3t - 4l = 11.134$; $5e - 4l = 14.776$; $3t - 5e = -3.642$

(15) $\frac{5}{6}$ 6 ob. 4691.600 5624.789 5624.277 4686.422 4679.048
Hence $6h - 5n = 23.179$

(16) $\frac{4}{5}$ 4 ob. 7040.067 7035.194 5624.765 7027.757
Hence $4t - 5n = -.426$

(17) $\frac{4}{\frac{5}{6}}$ 8 ob.
5068.936 6335.556 4222.377 5064.835 5060.250 4215.660 6322.912 6318.238
Hence $4p - 5k = -41.070$; $5k - 6e = 9.262$; $4p - 6e = 31.808$

(18) $\frac{4}{6}$ 15 ob. 4215.650 6322.903
Hence $6e - 4p = 31.776$

(19) $\frac{4}{5}$ 6 ob. 6564.418 6563.046 5270.501 5269.718
Hence $4q - 5l = -85.486$

(20) $\frac{5}{\frac{6}{7}}$ 4 ob. 5914.366 4222.354 4924.938 4924.098 4215.652 5896.150
Hence $5o - 6j = -50.947$; $6j - 7e = -28.009$; $5o - 7e = 78.956$

(21) $\frac{5}{\frac{6}{7}}$ 4 ob. 5914.376 4222.370 4924.952 4924.106 4215.652 5896.126
Hence $5o - 6j = -51.043$; $6j - 7e = -27.999$; $5o - 7e = 79.042$

(22) $\frac{5}{6}$ 6 ob. 5788.142 5791.202 4824.320 4823.696

TABLE V.

7,000 GRATING REVERSED.

(23) $\frac{4}{5}$ 6 ob. Nov. 15, 1884. Excellent set.
5896.158 5890.189 4703.164 4691.569 4690.324 4683.746
Hence $4o - 5h = 108.585$

(24) $\frac{4}{5}$ 4 ob. Excellent set.
4508.461 4501.444 5624.770 5624.254 4497.043 4494.711
Hence $5g - 4n = 13.512$

(25) $\frac{4}{5}$ 4 ob. 4222.369 5270.506 5269.725 4215.670
Hence $5e - 4l = 14.635$

(26) $\begin{array}{c}5\\\hline 6\\\hline 7\end{array}$ 4 ob.
5914.380 4222.382 4924.946 4924.110 4215.667 5896.161 5890.188 4903.472
Hence $5o - 6j = -50.920$; $6j - 7e = -28.115$; $7e - 5o = 79.035$

(27) $\frac{5}{6}$ 6 ob. 5270.501 5269.713 4376.107
Hence $5l - 6f = 93.893$

(28) $\frac{4}{5}$ 6 ob.
5914.389 5896.151 5890.190 4703.160 4691.569 4690.318 5862.586 5859.815 4683.739
Hence $4o - 5h = 108.596$

(29) $\frac{3}{4}$ 4 ob.
6569.455 4924.953 4294.109 6563.050 6546.494 4903.477 4859.911 6462.799 4824.291
4823.667
Hence $3q - 4j = 28.704$

(30) $\begin{array}{c}4\\\hline 5\\\hline 6\end{array}$ 6 ob.
6594.108 6593.164 5270.500 5269.720 6569.438 6563.060 5250.825 5250.398 4376.100
Hence $4r - 4q = 109.548$; $4q - 5l = -85.554$; $5l - 6f = 93.950$; $4q - 6f = 8.396$

(31) $\frac{3}{4}$ 12 ob. Excellent.
6884.080 5162.456

SIX-INCH CONCAVE GRATING, 21½ FEET FOCUS.

10,000 lines to inch.

$\frac{2}{3}$ Slit wide open to see *A*, so that definition was poor.

A.

5068.957 7621.300 5083.523 5090.974 5105.730
5068.943 7621.245 5083.513 5090.955 5105.709

TABLE VI.

COLLECTION OF OBSERVATIONS FROM ABOVE.

e.

Wt.	Ob.	
1	(8)	$4e - 3n = 2.552$
1	(8)	$= 2.538$
		$4e - 3n = 2.545$

Wt.	Ob.	
1	(6)	$5e - 4l = 14.739$
	(2)	$= 14.776$
1	(4 *R*)	$= 14.635$
		$5e - 4l = 14.691$

Ob	
(6)	$5e - 3t = 3.684$
(2)	$= 3.642$
	$5e - 3t = 3.673$

Ob.	
(8)	$6e - 5k = -9.262$

Wt.	Ob.	
2	(8)	$6e - 4p = +\ 31.808$
	(1.5)	$= 31.776$
1	(04)	$= 31.800$
	(010)	$= 31.902$
	(07)	$= 31.878$
	(04)	$= 31.796$
		$6e - 4p = 31.812$
		$\therefore 3e - 2p = 15.906$

Wt.	Ob.	
1	(4)	$7e - 6j = 28.009$
	(4)	$= 27.999$
1	(4 *R*)	$= 28.115$
		$7e - 6j = 28.060$

Wt.	Ob	
1	(4)	$7e - 5o = 78.956$
	(4)	$= 79.042$
1	(4 *R*)	$= 79.035$
		$7e - 5o = 79.017$

f.

Ob.	
(6 *R*)	$6f - 5l = -93.893$
(6 *R*)	$= -93.950$
	$6f - 5l = -93.921$

Ob	
(6 *R*)	$6f - 4q = -8.396$
(010)	$= -8.386$
(010)	$= -8.440$
	$6f - 4q = -8.407$

g.

Ob.	
(6)	$5g - 4n = 13.550$
(4 *R*)	$= 13.512$
	$5g - 4n = 13.531$

Ob.	
(8)	$6g - 5m = 5.581$

Wt.	Ob	
1	(8)	$6g - 4s = 12.290$
2	(04)	$= 12.326$
	(08)	$= 12.234$
	(010)	$= 12.260$
	(06)	$= 12.172$
		$6g - 4s = 12.258$

Ob.	
(4)	$7g - 5p = -86.633$

(4) $7g - 6l = -104.413$

h.

Wt.	Ob.	
4	(8)	$6h - 5n = 23.137$
2	(4)	$= 23.216$
3	(6)	$= 23.179$
		$6h - 5n = 23.169$

Wt.	Ob.	
1	(4)	$6h - 4t = 23.656$
2	(08)	$= 23.548$
	(04)	$= 23.504$
	(06)	$= 23.548$
		$6h - 4t = 23.577$

Ob.	
(4)	$5h - 4o = -108.549$
(6 *R*)	$= -108.585$
(6 *R*)	$= -108.596$
	$5h - 4o = -108.577$

j.

Wt. Ob.
1 (4) $6j - 5o = 50.947$
1 (4) $= 51.043$
1 (4 *R*) $= 50.920$
$6j - 5o = 50.970$

Ob.
(4) $6j - 7e = -28.009$
(4) $= -27.999$
(4 *R*) $= -28.115$
$6j - 7e = -28.060$

Ob.
(4 *R*) $4j - 3q = -28.704$

k.

Ob.
(8) $5k - 4p = 41.070$

Ob.
(8) $5k - 6e = 9.262$

l.

Ob.
(8) $6l - 5p = 17.779$
(8) $= 17.779$
(4) $= 17.791$
(4) $= 17.780$
$6l - 5p = 17.781$

Ob.
(4) $6l - 7g = 104.413$

Ob.
(6) $4l - 5e = -14.739$
(2) $= -14.776$
(4 *R*) $= -14.635$
$4l - 5e = -14.691$

Ob.
(6) $4l - 3t = -11.055$
(2) $= -11.134$
$4l - 3t = -11.075$

(6) $5l - 4q = 85.486$
(6 *R*) $= 85.554$
$5l - 4q = 85.520$

(6 *R*) $5l - 6f = 93.893$
(6 *R*) $= 93.950$
$5l - 6f = 93.921$

m.

Ob.
(8) $5m - 6g = -5.581$

Ob.
(8) $5m - 4s = 6.709$

n.

Ob.
(8) $3n - 4e = -2.552$
(8) $3n - 4e = -2.538$
$3n - 4e = -2.545$

Ob.
(8) $5n - 6h = -23.137$
(4) $= -23.216$
(6) $= -23.179$
$5n - 6h = -23.169$

Wt. Ob.
1 (6) $4n - 5g = -13.550$
1 (4 *R*) $= -13.512$
$4n - 5g = -13.531$

(4) $5n - 4t = .440$
(4) $= .426$
$5n - 4t = .433$

o.

Wt. Ob.
1 (4) $4o - 5h = 108.549$
1 (6 *R*) $= 108.585$
1 (6 *R*) $= 108.596$
$4o - 5h = 108.577$

Wt. Ob.
1 (4) $5o - 6j = -50.947$
1 (4) $= -51.043$
1 (4 *R*) $= -50.920$
$5o - 6j = -50.970$

Ob.
(4) $5o - 7e = -78.956$
(4) $= -79.042$
(4 *R*) $= -79.035$
$5o - 7e = -79.017$

p.

Ob.
(8) $5p - 6l = -17.779$
(8) $= -17.779$
(4) $= -17.791$
(4) $= -17.780$

$5p - 6l = -17.781$

Ob.
(4) $5p - 7g = 86.633$

Ob.
(8) $4p - 5k = -41.070$

Ob.
(8) $4p - 6e = -31.808$
(15) $= -31.776$
(04) $= -31.800$
(010) $= -31.902$
(07) $= -31.878$
(04) $= -31.796$

$4p - 6e = -31.812$

q.

Ob.
(6) $4q - 5l = -85.486$
(6 *R*) $= -85.554$

(6) $4q - 5l = -85.520$

Ob.
(4 *R*) $3q - 4j = 28.704$

Ob.
(6 *R*) $4q - 6f = 8.396$
(010) $= 8.386$
(010) $= 8.440$

$4q - 6f = 8.407$

(6 *R*) $4q - 4p = -109.548$

r.

(6 *R*) $4r - 4q = 109.548$

s.

Ob.
(8) $4s - 5m = 6.709$

Ob.
(8) $4s - 6g = -12.290$
(04) $= -12.336$
(08) $= -12.234$
(016) $= -12.260$
(06) $= -12.172$

$4s - 6g = -12.258$

t.

Ob.
(6) $3t - 4l = 11.055$
(2) $= 11.134$

$3t - 4l = 11.075$

Ob.
(6) $3t - 5e = -3.684$
(2) $= -3.642$

$3t - 5e = -3.673$

Ob.
(4) $4t - 5n = -.440$
(4) $= -.426$

$4t - 5n = -.433$

Ob.
(4) $4t - 6h = -23.656$
(08) $= -23.548$
(04) $= -23.504$
(06) $= -23.548$

$4t - 6h = -23.577$

TABLE VII.

Wt.	*e*	*f*	*g*	*h*	*j*	*k*	*l*	*m*	*n*	*o*	*p*	*q*	*s*	*t*	*o′*	
2	4 *e*								—3 *n*							= 2.545
3	5 *e*						—4 *l*									= 14.691
1	5 *e*													—3 *t*		= 3.673
2	6 *e*					—5 *k*										= —9.262
5×2	3 *e*										—2 *p*					= 15.906
3	7 *e*				—6 *j*											= 28.060
3	7 *e*									—5 *o*						= 79.017
3		6 *f*					—5 *l*									= —93.921
4		6 *f*										—4 *q*				= —8.407
3			5 *g*						—4 *n*							= 13.531
2			6 *g*					—5 *m*								= 5.581
4×2			3 *g*										—2 *s*			= 6.129
3				6 *h*					—5 *n*							= 23.169
3×2				3 *h*										—2 *t*		= 11.788
4				5 *h*						—4 *o*						= —108.577
1			7 *g*								—5 *p*					= —86.633
3					6 *j*					—5 *o*						= 50.970
1					4 *j*							—3 *q*				= —28.704
2						5 *k*					—4 *p*					= 41.070
4							6 *l*				—5 *p*					= 17.781
3							5 *l*					—4 *q*				= 85.520
1			—7 *g*				6 *l*									= 104.413
1							4 *l*							—3 *t*		= —11.075
2								5 *m*					—4 *s*			= 6.709
2			—4 *g*						5 *n*					—4 *t*		= .433
2															3 *o′*	= 16.275

TABLE VIII.

FIRST CALCULATION.

$e = 4219.024$

5	$3e = 12657.072$ -15.906	$2)12641.166 = 6320.583 = p$
2	$4e = 16876.096$ -2.545	$3)16873.551 = 5624.517 = n$
3	$5e = 21095.120$ -14.691	$4)21080.429 = 5270.107 = l$
2	$6e = 25314.144$ $+9.262$	$5)25323.406 = 5064.681 = k$
3	$7e = 29533.168$ -28.060	$6)29505.108 = 4917.518 = j$
3	$7e = 29533.168$ -79.017	$5)29454.151 = 5890.830 = o$
1	$5e = 21095.120$ -3.673	$3)21091.447 = 7030.482 = t$

(5) $p = 6320.583$

1	$5p = 31602.915$	$7)31516.282 = 4502.326 = g$	1
	-86.633		
2	$4p = 25282.332$	$5)25323.402 = 5064.680 = k$	2
	$+41.070$		
4	$5p = 31602.915$	$6)31620.696 = 5270.116 = l$	4
	$+17.781$		

(2) $n = 5624.517$

3	$5n = 28122.585$	$6)28145.754 = 4690.959 = h$	1
	$+23.169$		
2	$5n = 28122.585$	$4)28122.152 = 7030.538 = t$	1
	$-.433$		
3	$4n = 22498.068$	$5)22511.599 = 4502.320 = g$	1
	$+13.531$		

(3) $l = 5270.107$

3	$5l = 26350.535$	$6)26256.614 = 4376.102 = f$	2
	-93.921		
4	$6l = 31620.642$	$5)31602.861 = 6320.572 = p$	2
	-17.781		
3	$5l = 26350.535$	$4)26265.015 = 6566.254 = q$	2
	-85.520		
1	$6l = 31620.642$	$7)31516.229 = 4502.318 = g$	1
	-104.413		
1	$4l = 21080.428$	$3)21091.503 = 7030.501 = t$	1
	$+11.075$		

(2) $k = 5064.681$

2	$5k = 25323.405$	$4)25282.335 = 6320.584 = p$	1
	-41.070		

(3) $j = 4917.518$

3	$6j = 29505.108$	$5)29454.138 = 5890.828 = o$	2
	-50.970		
1	$4j = 19670.072$	$3)19698.776 = 6566.259 = q$	1
	$+28.704$		

(3) $o = 5890.830$

4	$4o = 23563.320$	$5)23454.743 = 4690.949 = h$	2
	-108.577		
3	$5o = 29454.150$	$6)29505.120 = 4917.520 = j$	2
	$+50.970$		

Collecting.

	Wt.			Wt.
e	10	4219.024	4219.024	10
f	2	4376.102	4376.102	2
g	1	4502.326		
	1	.320		
	1	.318	4502.321	3
h	1	4690.959		
	2	.949	4690.952	3
j	3	4917.518		
	2	.520	4917.519	5
k	2	5064.681		
	2	.680	5064.681	4
l	3	5270.107		
	4	.116	5270.112	7

	Wt.			Wt.
n	2	5624.517	5624.517	2
o	3	5890.830		
	2	.828	5890.829	5
p	5	6320.583		
	2	.572		
	1	.584	6320.580	8
q	2	6566.254		
	1	.259	6566.256	3
t	1	7030.482		
	1	.538		
	1	.501	7030.507	3

(10) $e = 4219.024$

Wt.		
3	$j = 4917.518$	2
2	$k = 5064.681$	2
3	$l = 5270.107$	2
2	$n = 5624.517$	2
3	$o = 5890.830$	2
5	$p = 6320.583$	3
1	$t = 7030.482$	1

(2) $f = 4376.102$

3	$6f = 26256.612$ $+ 93.921$	$5)26350.533 = 5270.107 = l$	2
4	$6f = 26256.612$ $+ 8.407$	$4)26265.019 = 6566.255 = q$	2

(3) $g = 4502.321$

3	$5g = 22511.605$ $- 13.531$	$4)22498.074 = 5624.518 = n$	2
2	$6g = 27013.926$ $- 5.581$	$5)27008.345 = 5401.669 = m$	1
4	$3g = 13506.963$ $- 6.129$	$2)13500.834 = 6750.417 = s$	2
1	$7g = 31516.247$ $+ 86.633$	$5)31602.880 = 6320.576 = p$	1

(3) $h = 4690.952$

3	$6h = 28145.658$	$5)28122.489 = 5624.509 = n$	(2)
	-23.169		
3	$3h = 14072.829$	$2)14061.041 = 7030.534 = t$	(2)
	-11.788		
4	$5h = 23454.715$	$4)23563.292 = 5890.834 = o$	(2)
	$+108.577$		

(5) $j = 4917.519$

3	$6j \quad 29505.114$	$7)29533.174 = 4219.025 = e$	2
	$+28.060$		
3	$6j = 29505.114$	$5)29454.144 = 5890.829 = o$	2
	-50.970		
1	$4j = 19670.076$	$3)19698.780 = 6566.260 = q$	1
	$+28.704$		

(2) $k = 5064.681$

2	$4219.024 = e$	(1)
2	$6320.584 = p$	(1)

(7) $l = 5270.112$

3	$4l = 21080.448$	$5)21095.139 = 4219.028 = e$	(3)
	$+14.691$		
3	$5l = 26350.560$	$6)26256.639 = 4376.106 = f$	(3)
	-93.921		
4	$6l = 31620.672$	$5)31602.891 = 6320.578 = p$	(3)
	-17.781		
3	$5l = 26350.560$	$4)26265.040 = 6566.260 = q$	(3)
	-85.520		
1	$6l = 31620.672$	$7)31516.259 = 4502.323 = g$	1
	-104.413		
1	$4l = 21080.448$	$3)21091.523 = 7030.508 = t$	1
	$+11.075$		

(2) $n = 5624.517$

2	$3n = 16873.551$ $+ 2.545$	$4)16876.096 = 4219.024 = e$	1
3	$4n = 22498.068$ $+ 13.531$	$5)22511.599 = 4502.320 = g$	1
3	$5n = 28122.585$ $+ 23.169$	$6)28145.754 = 4690.959 = h$	1
2	$5n = 28122.585$ $- 0.433$	$4)28122.152 = 7030.538 = t$	1

(5) $o = 5890.829$

3	$5o = 29454.145$ $+ 79.017$	$7)29533.162 = 4219.023 = e$	2
4	$4o = 23563.316$ $- 108.577$	$5)23454.739 = 4690.948 = h$	2
3	$5o = 29454.145$ $+ 50.970$	$6)29505.115 = 4917.519 = j$	2

(8) $p = 6320.580$

5	$2p = 12641.160$ $+ 15.906$	$3)12657.066 = 4219.022 = e$	3
1	$5p = 31602.900$ $- 86.633$	$7)31516.267 = 4502.324 = g$	1
2	$4p = 25282.320$ $+ 41.070$	$5)25323.390 = 5064.678 = k$	2
4	$5p = 31602.900$ $+ 17.781$	$6)31620.681 = 5270.113 = l$	3

(3) $q = 6566.256$

4	$4q = 26265.024$ $- 8.407$	$6)26256.617 = 4376.103 = f$	2
1	$3q = 19698.768$ $- 28.704$	$4)19670.064 = 4917.516 = j$	1
3	$4q = 26265.024$ $+ 85.520$	$5)26350.544 = 5270.109 = l$	2

Résumé.—First Calculation.

e	2	4219.025		
	3	.028		
	1	.024		
	2	.023		
	3	.022		
	1	.024	4219.025	(12)
f	3	4376.106		
	2	.103	4376.105	(5)
g	1	4502.323		
	1	.320		
	1	.324	4502.322	(3)
h	1	4690.959		
	2	.948	4690.952	(3)
j	2	4917.518		
	2	.519		
	1	.516	4917.518	(5)
k	2	5064.681		
	2	.678	5064.680	(4)
l	2	5270.107		
	2	.107		
	3	.113		
	2	.109	5270.109	(9)

m	1	5401.669	5401.669	(1)
n	2	5624.517		
	2	.518		
	2	.509	5624.515	(6)
o	2	5890.830		
	2	.834		
	2	.829	5890.831	(6)
p	3	6320.583		
	1	.576		
	1	.584		
	3	.578	6320.580	(8)
q	2	6566.255		
	1	.260		
	3	.260	6566.258	(6)
s	2	6750.417	6750.417	(2)
t	1	7030.482		
	2	.534		
	1	.508		
	1	.538	7030.519	(5)

SECOND CALCULATION.

$o = 5890.830$

4	$4o = 23563.320$	$5)23454.743 = 4690.949 = h$	4
	-108.577		
3	$5o = 29454.150$	$6)29505.120 = 4917.520 = j$	3
	$+50.970$		
3	$5o = 29454.150$	$7)29533.167 = 4219.024 = e$	3
	$+79.017$		

(4) $4690.949 = h$

3	$6h = 28145.694$	$5)28122.525 = 5624.505 = n$	2
	-23.169		
3	$6h = 28145.694$	$4)28122.117 = 7030.529 = t$	2
	-23.577		

(3) $4917.520 = j$

1	$4j = 19670.080$	$3)19698.784 = 6566.261 = q$	1
3	$+28.704$	$4219.026 = e$	2

(3) $4219.024 = e$

2	$4e = 16876.096$	$3)16873.551 = 5624.517 = n$	1
	-2.545		
3	$5e = 21095.120$	$4)21080.429 = 5270.107 = l$	2
	-14.691		
1	$5e = 21095.120$	$3)21091.447 = 7030.482 = t$	1
	-3.673		
5	$3e = 12657.072$	$2)12641.166 = 6320.583 = p$	2
	-15.906		
2	$6e = 25314.144$	$5)25323.406 = 5064.681 = k$	1
	$+9.262$		
3	$7e = 29533.168$	$6)29505.108 = 4917.518 = j$	2
	-28.060		

e	3	4219.024		
	2	.026	4219.025	(5)
h	4	4690.949	4690.949	(4)
j	3	4917.520		
	2	.518	4917.519	(5)
k	1	5064.681	5064.681	(1)
l	2	5270.107	5270.107	(2)

n	2	5624.505		
	1	.517	5624.509	(3)
o		5890.830	5890.830	
p	2	6320.583	6320.583	(2)
q	1	6566.261	6566.261	(1)
t	1	7030.482		
	2	.529	7030.513	(3)

$e = 4219.025$ (3)

(2)	$4e = 16876.096$ -2.545	$3)16873.551 = 5624.518 = n$	(1)
(3)	$5e = 21095.120$ -14.691	$4)21080.429 = 5270.108 = l$	(2)
(1)	$5e = 21095.120$ -3.673	$3)21091.447 = 7030.483 = t$	(1)
(5)	$3e = 12657.072$ -15.906	$2)12641.166 = 6320.584 = p$	(2)
(2)	$6e = 25314.144$ $+9.262$	$5)25323.406 = 5064.682 = k$	(1)
(3)	$7e = 29533.168$ -28.060	$6)29505.108 = 4917.519 = j$	(2)
(3)	$7e = 29533.167$ -79.017	$5)29454.150 = 5890.831 = o$	(2)

$h = 4690.949$ (4)

(3)	$6h = 28145.694$ -23.169	$5)28122.525 = 5624.505 = n$	(2)
(3)	$6h = 28145.694$ -23.577	$4)28122.117 = 7030.529 = t$	(2)
(4)	$5h = 23454.743$ $+108.577$	$4)23563.320 = 5890.830 = o$	(2)

$j = 4917.519$ (5)

(1)	$4j = 19670.076$ $+28.704$	$3)19698.780 = 6566.260 = q$	(1)
(3)	$6j = 29505.114$ $+28.060$	$7)29533.174 = 4219.025 = e$	(2)
(3)	$6j = 29505.114$ -50.970	$5)29454.144 = 5890.829 = o$	(2)

$k = 5064.681$ (1)

2	$5k = 25323.406$ -9.262	$6)25314.144 = 4219.024 = e$	(1)
2	$5k = 25323.406$ -41.070	$4)25282.336 = 6320.584 = p$	(1)

$l = 5270.107$ (2)

(3) $4l = 21080.429$ $5)21095.120 = 4219.024 = e$ (1)
$+14.691$
(3) $5l = 26350.535$ $4)26265.015 = 6566.254 = q$ (1)
-85.520
(4) $6l = 31620.642$ $5)31602.861 = 6320.572 = p$ (2)
-17.781
(3) $5l = 26350.535$ $6)26256.614 = 4376.102 = f$ (1)
-93.921
(1) $6l = 31620.642$ $7)31516.229 = 4502.318 = g$ (1)
-104.413
(1) $4l = 21080.429$ $3)21091.504 = 7030.501 = t$ (1)
$+11.075$

$n = 5624.509$ (3)

(2) $3n = 16873.527$ $4)16876.072 = 4219.018 = e$ (1)
$+2.545$
(3) $4n = 22498.036$ $5)22511.567 = 4502.313 = g$ (2)
$+13.531$
(3) $5n = 28122.545$ $6)28145.714 = 4690.952 = h$ (2)
$+23.169$
(2) $5n = 28122.545$ $4)28122.112 = 7030.528 = t$ (1)
$-.433$

$o = 5890.830$ (10)

(4) $4o = 23563.320$ $5)23454.743 = 4690.949 = h$ (4)
-108.577
(3) $5o = 29454.150$ $6)29505.120 = 4917.520 = j$ (3)
$+50.970$
(3) $5o = 29454.150$ $7)29533.167 = 4219.024 = e$ (3)
$+79.017$

$p = 6320.583$ (2)

(5) $2p = 12641.166$ $3)12657.072 = 4219.024 = e$ (2)
$+15.906$
(1) $5p = 31602.915$ $7)31516.282 = 4502.326 = g$ (1)
-86.633
(2) $4p = 25282.332$ $5)25323.402 = 5064.680 = k$ (1)
$+41.070$
(4) $5p = 31602.915$ $6)31620.696 = 5270.116 = l$ (2)
$+17.781$

$q = 6566.261$ (1)

(4) $4q = 26265.044$ $6)26256.637 = 4376.106 = f$ (1)
-8.407
(1) $3q = 19698.783$ $4)19670.079 = 4917.520 = j$ (1)
-28.704
(3) $4q = 26265.044$ $5)26350.564 = 5270.113 = l$ (1)
$+85.520$

$g = 4502.317$ (4)

2 $6g = 27013.902$ $5)27008.321 = 5401.664 = m$ (1)
-5.581
4 $3g = 13506.951$ $2)13500.822 = 6750.411 = s$ (2)
-6.129

$s = 6750.411$ (2)

$4s = 27001.644$ $5)27008.353 = 5401.671$ (1)
$+6.709$

$m = 5401.664$ (1)

$5m = 27008.320$ $4)27001.611 = 6750.403$
-6.709

Résumé. — Second Calculation.

e	2	4219.025		
	2	.025		
	1	.024		
	1	.024		
	1	.018		
	3	.024		
	2	.024	4219.024	(10)
f	1	4376.102		
	1	.106	4376.104	(2)
g	1	4502.318		
	2	.313		
	1	.326	4502.317	(4)
h	2	4690.952		
	4	.949	4690.950	(6)
j	2	4917.519		
	3	.520		
	1	.520	4917.520	(6)
k	1	5064.682		
	1	.680	5064.681	(2)
l	2	5270.108		
	2	.116		
	1	.113	5270.112	(5)

m	1	5401.671		
	1	.664	5401.667	
n	1	5624.518		
	2	.505	5624.509	(3)
o	2	5890.831		
	2	.830		
	2	.829	5890.830	(6)
p	2	6320.584		
	1	.584		
	2	.572	6320.579	(5)
q	1	6566.260		
	1	.254	6566.257	(2)
s	2	6750.411		
	1	.403	6750.408	
	1	7030.483		
	2	.529		
	1	.501		
	1	.528	7030.514	(5)

TABLE IX.

TABLE OF PRIMARY STANDARDS.

	First.	Second.	Mean.	Relative Wave Lengths.	Absolute Standards.
e	4219.025	4219.024	4219.025	4215.667 4222.383	4215.665 4222.381
f	4376.105	4376.104	4376.105	4376.105	4376.103
g	4502.322	4502.317	4502.320	4494.731 4497.050 4501.447 4508.462	4494.729 4497.048 4501.444 4508.460
h	4690.952	4690.950	4690.951	4690.325 4694.577	4690.323 4691.575
j	4917.518	4917.529	4917.519	4903.486 4924.112 4924.958	4903.484 4924.110 4924.956
k	5064.680	5064.681	5064.680	5060.253 5064.837 5068.949	5060.250 5064.834 5068.946
l	5270.109	5270.112	5270.110	5269.720 5270.500	5269.717 5270.497
m	5401.669	5401.667	5401.668	5397.351 5405.985	5397.250 5405.984
n	5624.515	5624.509	5624.512	5624.257 5624.767	5624.254 5624.764
o	5890.831	5890.830	5890.830	5862.585 5890.187 5896.160 5914.389	5862.582 5890.184 5896.157 5914.386
p	6320.580	6320.579	6320.580	6246.533 6318.244 6322.915	6246.530 6318.241 6322.912
q	6566.258	6566.257	6566.258	6563.052 6564.397 6569.464	6563.049 6564.394 6569.461
s	6750.417	6750.408	6750.412	6750.412	6750.409
t	7030.519	7030.514	7030.516	7023.754 7027.731 7040.063	7023.747 7027.724 7040.056

From the foregoing we also find the mean of *g* to be 7621.282, and the absolute standard 7621.278.

DETERMINATION OF *A*.

By running the micrometer across from the first to the second spectrum of a grating with 21½ feet focus and 10,000 lines to the inch, I obtained the wave lengths of lines in *A* more accurately than had ever before been obtained, but still without the accuracy of the rest of the measures. The reason of this was the very long distance to be measured in an interval so very faint in light as to render it necessary to open the slit wide. The following results were obtained: —

		Mean.
7594.07	7593.98	7594.02
7621.30	.15	.22
7623.57	.38	.47
7624.86	.71	.78

A 10,000 grating was finally found in which the *A* line could be seen in the second spectrum, and hence its coincidence with the third spectrum determined.

But the slit had to be so wide as greatly to injure the definition. Besides, the green of the third spectrum was so bright as partly to blind the eyes to the *A* line when the proper absorbing medium was put in. However, fairly satisfactory results were obtained as follows: —

5068.964	7621.310	5083.530	5090.981	5105.737
5068.950	7621.255	5083.520	5090.962	5105.716
5068.957	7621.282	5083.525	5090.971	5105.726

Each of these is the mean of many readings, and the agreement is not specially good.

TABLE X.

DESCRIPTION OF TABLE.

In the first column is the metal to which the line measured is supposed to belong. Where a solar line is measured, it often belongs to several metals, though the lines are rarely coincident. When they are apparently coincident, they are written on one line, thus, *Fe*, *Ti*. If the iron had coincided with the violet side and the *Ti* with the red side it would have been written thus: ${}^{Fe}_{Ti}\!>$. Had the iron line coincided with the violet side only, and the *Ti* not at all, it would have been written thus: ${}^{Fe}_{\,?}\!>$.

The column giving the intensity in the arc is a very rough attempt only at the intensity as it appeared on the plates, without attempting to define the strongest line by any fixed number. The stronger the line the larger the number. The intensities in the solar spectrum are also only roughly estimated.

In the next column the fifteen visible standards are placed together with the *A* line and another group at about 7200, which were used as standards in this difficult region. Next to these, wider sets of lines depending on these were used as the standards, so that the mean of a number of observations could be taken.

The eye observations are marked with letters *p*, *q*, *R*, *C*, etc.

The photographic plates, most of which have coincidences with the blue-violet or ultra-violet, are marked Plate 1, Plate 2, etc., to Plate 23, and extend through the whole solar spectrum from wave line 3005 to 7201.

The plates having the solar spectrum and metallic spectra of different orders, or metallic spectra alone, are marked ⊙ M. 44 ii, M. 29 iii, M. 22 iv, etc., and were taken with a grating having 20,000 lines to the inch. The mark means that the solar and metallic spectra were taken at wave length 4400 in the second spectrum, and the metallic spectra at 2900 in the third, and 2200 in the fourth, were also on the plate.

The substandards are put in where required, in italic.

The small letters *a*, *b*, *c*, refer to the dividing engines used for measurement. ⊙ means solar, and *M* metallic, and *R* reversed.

	Intensity in Arc	Intensity in Sun	Nature in Arc	Kind of Standard		⊙ M 44 II, M 29 III, M 22 IV							⊙ M 48 II, M 32 III, M 24 IV						
						Ca J c M	Sr J c M	Fe J c M	Si I′ J c M	Si H J a M	Si I J a M	Si J J a M	Mg J c M	Si J b M	Si J c M	† J b M	† J b M	C J b M	Sn J c M
Sr	2	. .	. .	M	2152	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Sr	3	. .	. .	M	2165	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Si	2	. .	. .	M	2208	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Si	3	. .	. .	M	2210	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Si	2	. .	. .	M	2211	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Si	4	. .	. .	M	2216	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Si	2	. .	. .	M	2218	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Al	3	. .	. .	M	2263	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Al	4	. .	. .	M	2269	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Sr	10	. .	R	M	2275	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ca	20	. .	R	M	2275	587	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe?	. .	. .	. .	M	2298	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ba	20	. .	R	M	2304	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ba	20	. .	R	M	2335	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2343	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2348	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2364	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Al	6	. .	. .	M	2367	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Al	7	. .	. .	M	2373	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2373	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe?	. .	. .	. .	M	2382	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2388	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe?	. .	. .	. .	M	2395	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ca	25	. .	R	M	2398	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2399	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2404	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2406	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2410	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Si	8	. .	. .	M	2435	. .	. .	. .	. .	. .	. .	. .	. .	242	249	233	. .	255	. .
Si	3	. .	. .	M	2438	. .	. .	. .	. .	. .	. .	. .	. .	. .	856	. .	. .	. .	. .
Si	3	. .	. .	M	2443	. .	. .	. .	. .	. .	. .	. .	. .	. .	452	. .	. .	. .	. .
Fe?	. .	. .	. .	M	2447	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Si	3	. .	. .	M	2452	. .	. .	. .	. .	. .	. .	. .	. .	. .	197	. .	. .	. .	. .
Fe?	. .	. .	. .	M	2457	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2462	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2472	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .

---

* The solar spectrum at 48 was not used in this series, but only the metal spectrum at 32.

† These results were obtained by interpolation between the Mg lines at 4571 and 4703 at one end, and 5172 and 5183 at the other, using the theoretical correction for length of plate. The Mg lines, and the Bo and Si were in the 1st and 2nd spectra instead of the 2nd and 4th.

⊙ M 40 II, M 27 III					⊙ M 36 II, M 24 III								Sub-standard	M 24 I			Mean M
Mg J a M	Mg J b M	Mg J b M	Si D J a M	Si E J a M	Si G J a M	Si G J a M	Si G J c M	Si F J a M	Si F J c M	Ca J c M	Fe J c M	Th J c M		Sr J c M	Ba J c M	Ca J c M	
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	912	. .	. .	912
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	990	. .	. .	990
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	034	. .	086	060
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	928	. .	950	939
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	758	. .	760	759
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	759	. .	760	760
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	126	. .	165	146
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	487	. .	526	507
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	140	. .	183	161
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	376	. .	. .	376
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	616	602
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	234	. .	257	246
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	264	. .	364
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	267	. .	267
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	562	. .	579	571
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	399	. .	371	385
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	882	. .	912	897
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	139	147	146	144
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	195	237	207	213
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	754	. .	787	771
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	114	117	135	122
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	703	. .	717	710
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	698	726	722	715
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	670	. .	. .	. .	647	672	678	667
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	301	. .	354	328
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	963	. .	979	971
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	729	. .	756	743
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	603	. .	605	604
. .	. .	. .	. .	. .	248	248	250	251	260	. .	256	. .	*243*	228	234	256	247
. .	. .	. .	. .	. .	871	867	871	870	880	. .	. .	. .	*865*	858	840	865	864
. .	. .	. .	. .	. .	461	462	468	470	478	. .	. .	. .	*460*	446	. .	445	460
. .	. .	. .	. .	. .	. .	. .	775	. .	. .	. .	. .	. .	. .	771	. .	808	785
. .	. .	. .	. .	. .	215	217	220	220	232	. .	. .	. .	*210*	211	. .	243	219
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	682	675	684	680
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	743	744	743	743
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	969	980	974	974

	Intensity in Arc	Intensity in Sun	Nature in Arc	Kind of Standard		⊙ M 44 II, M 29 III, M 22 IV							⊙ M 48 II, M 32 III, M 24 IV						
						Ca J c M	Sr J c M	Fe J c M	Si I′ J c M	Si H J a M	Si I J a M	Si J J a M	Mg J c M	Si J b M	Si J c M	† J b M	† J b M	C J b M	Sn J c M
C	10	..	..	M	2478*	..	..	..	..	..	..	..	..	..	660	647	..	670	..
Fe	..	..	..	M	2479	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Fe	..	..	..	M	2483	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Fe	..	..	..	M	2484	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Fe	..	..	..	M	2488	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Fe	..	..	..	M	2489	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Fe	..	..	..	M	2490	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Fe	..	..	..	M	2491	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Bo	15	..	..	M	2496	..	..	..	..	..	..	..	865	859	863	854	854	874	858
Bo	20	..	..	M	2497	..	..	..	..	..	..	..	828	813	815	808	809	826	821
Fe	..	..	..	M	2501	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Si	10	..	..	M	2506	..	..	..	..	..	..	..	..	..	..	980	984	004	..
Fe	..	..	..	M	2510	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Si	7	..	..	M	2514	..	..	..	..	..	..	..	..	..	..	402	403	..	..
Si	15	..	..	M	2516	..	..	..	..	..	..	..	..	..	..	203	206	..	..
Fe	..	..	..	M	2518	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Si	8	..	..	M	2519	..	..	..	..	..	..	..	..	..	..	289	292	..	..
Fe	..	..	..	M	2522	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Si	9	..	..	M	2524	..	..	..	..	..	..	..	..	..	..	198	208	..	..
Fe	..	..	..	M	2527	..	..	..	..	..	..	..	..	..	..	..	606	..	..
Si	10	..	..	M	2528	..	..	..	..	..	..	..	..	..	..	595	..	..	..
Fe	..	..	..	M	2535	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Hg	100	..	R	M	2536	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Fe	..	..	..	M	2541	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Fe	..	..	..	M	2546	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Fe	..	..	..	M	2549	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Al	..	..	..	M	2568	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Al	..	..	..	M	2575	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Mn	..	..	..	M	2576	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Fe?	..	..	..	M	2584	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Fe	..	..	..	M	2585	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Mn	..	..	..	M	2593	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Fe	..	..	..	M	2598	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Fe	..	..	..	M	2599	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Fe	..	..	..	M	2611	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Fe	..	..	..	M	2631	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Si	5	..	..	M	2631	..	..	..	..	..	..	..	..	..	..	..	..	..	..

* This line seems to be the only single line of carbon not belonging to a band in the arc spectrum. It was determined to belong to *c* by the spark spectrum.

† These results were obtained by interpolations between the Mg lines at 4571 and 4703 at one end, and 5172 and 5183 at the other, using the theoretical correction for length of plate. The Mg lines and the Bo and Si were in the 1st and 2nd spectra instead of the 2nd and 4th.

⊙ M 40 II, M 27 III					⊙ M 36 II, M 24 III								Sub-stand-ard	M 24 I			Mean
Mg J a M	Mg J b M	Mg J b M	Si D J a M	Si E J a M	Si G J a M	Si G J a M	Si G J c M	Si F J a M	Si F J c M	Ca J c M	Fe J c M	Th J c M		Sr J c M	Ba J c M	Ca J c M	M
. .	. .	. .	. .	. .	. .	. .	666	. .	658	. .	660	. .	*660*	658	677	655	661
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	860	878	874	871
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	351	371	355	359
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	286	280	283	283
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	237	243	234	238
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	828	839	847	838
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	706	733	731	723
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	240	247	246	244
. .	. .	. .	. .	. .	. .	. .	873	. .	872	876	869	872	*867*	877	874	871	867
. .	. .	. .	. .	. .	. .	. .	828	. .	826	827	835	826	*823*	817	820	821	821
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	218	223	228	223
. .	. .	. .	. .	. .	. .	. .	006	. .	011	. .	. .	998	000	000	990	991	994
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	931	944	928	934
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	416	. .	422	444	415	417
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	227	212	204	210
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	199	175	190	188
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	298	. .	292	312	296	297
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	949	949	945	948
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	209	. .	210	215	195	206
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	530	538	521	530
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	615	680	597	599
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	702	693	702	699
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	625	671	. .	648
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	065	044	064	058
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	064	076	063	068
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	704	. .	703	704
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	089	086	079	085
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	198	208	188	198
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	200	. .	189	195
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	631	. .	626	629
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	965	. .	961	963
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	812	. .	808	810
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	470	. .	450	460
. .	. .	. .	493	494	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	494
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	964	. .	965	965
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	110	. .	139	125
. .	. .	. .	382	383	. .	. .	. .	. .	. .	. .	. .	. .	*383*	390	381	425	392

	Intensity in Arc	Intensity in Sun	Nature in Arc	Kind of Standard		⊙ M 44 II, M 29 III, M 22 IV						
						Ca J C M	Sp J C M	Fe J C M	Si I′ J C M	Si H J a M	Si I J a M	Si J J a M
Fe	. .	. .	. .	M	2679	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2706	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2719	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2720	. .	. .	. .	. .	. .	. .	. .
Ca	5	. .	. .	M	2721	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2723	. .	. .	. .	. .	. .	. .	. .
Fe?	. .	. .	. .	M	2733	. .	. .	. .	. .	. .	. .	. .
Fe?	. .	. .	. .	M	2737	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2742	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2750	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2755	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2756	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2761	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2762	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2767	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2772	. .	. .	. .	. .	. .	. .	. .
Mg	5	. .	R	M	2776	. .	. .	. .	. .	. .	. .	. .
Mg	5	. .	R	M	2778	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2778	. .	. .	. .	. .	. .	. .	. .
Mg	8	. .	R	M	2779	. .	. .	. .	. .	. .	. .	. .
Mg	5	. .	R	M	2781	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2781	. .	. .	. .	. .	. .	. .	. .
Mg	5	. .	R	M	2783	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2788	. .	. .	. .	. .	. .	. .	. .
Mn	. .	. .	. .	M	2794	. .	. .	. .	. .	. .	. .	. .
Mg	20	. .	R	M	2795	638	629	. .	639	. .	. .	. .
Mn	. .	. .	. .	M	2798	. .	. .	. .	. .	. .	. .	. .
Mn	. .	. .	. .	M	2801	. .	. .	. .	. .	. .	. .	. .
Mg	20	. .	R	M	2802	816	808	. .	. .	. .	. .	. .
Fe	5	. .	. .	M	2813	388	375	. .	398	. .	. .	. .
Fe	3	. .	. .	M	2823	389	. .	. .	. .	. .	. .	. .
Fe	5	. .	. .	M	2825	667	. .	. .	. .	. .	. .	. .
Fe	4	. .	. .	M	2832	549	. .	549	549	. .	. .	. .
Fe	3	. .	. .	M	2838	226	. .	. .	. .	. .	. .	. .
Fe	3	. .	. .	M	2843	744	. .	. .	. .	. .	. .	. .
Fe	5	. .	. .	M	2844	082	. .	080	083	. .	. .	. .
Fe	6	. .	. .	M	2851	906	. .	908	902	. .	. .	. .
Mg	100	. .	R	M	2852	236	239	241	234	235	240	. .

⊙ M 48 II, M 32 III, M 22 IV						⊙ M 40 II, M 27 III					Sub-stand-ard	M 24 I			Mean M
Ba M	Mg J c M	Si J b M	Si J c M	C J b M	Sn J c M	Mg J a M	Mg J b M	Mg J b M	Si D J a M	Si E J a M		Sp J c M	Ba J c M	Ca J c M	
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	159	126	159	148
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	700	. .	667	684
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	133	108	116	119
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	996	986	984	989
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	762	762
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	682	658	664	668
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	690	657	671	673
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	416	405	395	405
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	510	473	472	485
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	240	237	233	237
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	840	. .	833	837
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	428	411	443	427
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	871	. .	881	876
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	081	. .	139	110
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	638	. .	621	630
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	208	. .	203	206
. .	. .	. .	. .	. .	. .	800	801	801	. .	. .	*800*	793	. .	793	798
. .	. .	. .	. .	. .	. .	383	381	380	. .	. .	*381*	. .	. .	. .	381
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	355	. .	325	340
. .	. .	. .	. .	. .	. .	938	935	933	. .	. .	*935*	948	. .	933	935
. .	. .	. .	. .	. .	. .	525	523	515	. .	. .	*521*	516	. .	525	521
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	945	945
. .	. .	. .	. .	. .	. .	080	077	074	. .	. .	*077*	075	. .	081	077
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	209	195	199	201
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	908	920	905	911
. .	. .	. .	. .	. .	. .	628	630	626	. .	. .	*632*	647	624	627	632
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	370	366	371	369
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	189	178	183	183
. .	. .	. .	. .	. .	. .	800	802	796	. .	. .	*806*	806	803	807	805
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	*387*	401	382	386	388
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	389
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	667
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	535	544	541	545
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	226
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	744
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	088	092	082	085
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	898	. .	. .	904
240	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	238	249	233	239

	Intensity in Arc	Intensity in Sun	Nature in Arc	Kind of Standard		Pl 20 ⊙ 62 I ⊙ 31 II	⊙ M 44 II, M 29 III, M 22 IV								Substandard
						J c ⊙	Ca J c M	Sr J c M	Fe J c M	Si I′ J c M	Si H J a M	Si I J a M	Si J J a M	Ba J c M	
Si	15	. .	. .	M	2881	. .	696	710	695	683	696	693	687	697	. .
Fe	7	. .	R	M	2912	. .	276	. .	280	270	. .	. .	. .	. .	. .
Fe	8	. .	R	M	2929	. .	118	. .	140	124	. .	. .	. .	. .	. .
Fe	10	. .	R	M	2937	. .	016	008	037	017	. .	. .	. .	. .	. .
Fe	8	. .	R	M	2947	. .	998	984	999	992	. .	. .	. .	. .	. .
Fe	7	. .	R	M	2954	. .	062	050	056	063	. .	. .	. .	. .	. .
Fe	5	. .	. .	M	2957	. .	485	. .	489	481	. .	. .	. .	. .	. .
Fe	5	. .	. .	M	2965	. .	380	. .	382	381	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2966	. .	985	. .	. .	. .	. .	. .	. .	. .	. .
Fe	8	. .	R	M	2967	. .	. .	012	021	015	013	013	015	017	*015*
Fe	4	. .	R	M	2970	. .	213	. .	229	221	. .	. .	. .	. .	*221*
Fe	6	. .	R	M	2973	. .	251	. .	257	252	255	255	252	. .	*254*
Fe	12	. .	R	M	2973	. .	358	345	349	355	361	353	356	369	*356*
Fe	2	. .	. .	M	2981	. .	566	. .	573	561	. .	. .	. .	. .	. .
Fe	10	. .	R	M	2983	. .	691	680	695	688	688	687	686	695	*689*
Fe	. .	. .	. .	M	2987	. .	410	. .	. .	. .	. .	. .	. .	. .	. .
Si	4	. .	. .	M	2987	. .	773	. .	. .	763	766	765	763	. .	*766*
Fe	8	. .	R	M	2994	. .	545	550	550	544	549	547	542	556	*548*
Ca	7	. .	R	M	2995	. .	076	. .	. .	. .	. .	. .	. .	. .	. .
Ca	10	. .	R	M	2997	. .	429	. .	. .	. .	. .	. .	. .	. .	. .
Fe	4	. .	R	M	2999	. .	633	. .	639	631	. .	. .	. .	. .	. .
Ca	6	. .	R	M	2999	. .	764	. .	. .	. .	. .	. .	. .	. .	. .
Ca	8	. .	R	M	3000	. .	973	. .	. .	. .	. .	. .	. .	. .	. .
Fe	8	. .	R	M	3001	. .	079	. .	072	067	068	065	065	068	*069*
	. .	. .	. .	⊙	3005	160	. .	. .	. .	. .	. .	. .	. .	. .	. .
	. .	. .	. .	⊙	3005	404	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ca	15	. .	R	M	3006	. .	980	. .	. .	. .	. .	. .	. .	. .	. .
Fe	2	. .	. .	M	3007	. .	260	. .	. .	. .	. .	. .	. .	. .	. .
Fe	1	. .	. .	M	3007	. .	403	. .	411	409	. .	. .	. .	. .	. .
Fe	6	. .	R	M	3008	. .	258	251	264	258	260	254	246	. .	*256*
Ca	7	. .	R	M	3009	. .	330	. .	. .	. .	. .	. .	. .	. .	. .
Fe	4	. .	R	M	3009	. .	696	. .	698	693	. .	. .	. .	. .	. .
	. .	4	. .	⊙′	3012	548	. .	. .	. .	. .	. .	. .	. .	. .	. .
	. .	6	. .	⊙′	3014	245	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	3	. .	M	3016	. .	296	. .	. .	. .	. .	. .	. .	. .	. .

M 24 I			⊙ M 32 II												Mean	
Sr J c M	Ba J c M	Ca J c M	Prd J b ⊙	Prd J b M	Ca J c ⊙	Ca J c M	Ba J b ⊙	Ba J b M	Sr J b ⊙	Sr J b M	Co J b ⊙	Co J b M	Si J b ⊙	Si J b M	⊙	M
. .	. .	702	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	695
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	275
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	127
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	020
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	993
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	058
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	485
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	381
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	985
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	019	. .	016	. .	. .	. .	016
. .	. .	. .	. .	. .	. .	229	. .	. .	. .	. .	. .	224	. .	. .	. .	223
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	254
. .	. .	. .	. .	. .	. .	368	. .	. .	. .	. .	. .	370	. .	. .	. .	358
. .	. .	. .	. .	. .	. .	578	. .	. .	. .	. .	. .	. .	. .	. .	. .	570
. .	. .	. .	. .	. .	. .	699	. .	. .	. .	687	. .	684	. .	. .	. .	689
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	410
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	766
. .	. .	. .	. .	559	. .	547	. .	554	. .	543	. .	555	. .	519	. .	547
. .	. .	. .	. .	. .	. .	081	. .	. .	. .	. .	. .	. .	. .	. .	. .	074
. .	. .	. .	. .	. .	. .	430	. .	. .	. .	. .	. .	. .	. .	. .	. .	430
. .	. .	. .	. .	. .	. .	. .	. .	623	. .	. .	. .	. .	. .	. .	. .	632
. .	. .	. .	. .	. .	. .	769	. .	. .	. .	. .	. .	. .	. .	. .	. .	767
. .	. .	. .	. .	. .	. .	979	. .	. .	. .	. .	. .	. .	. .	. .	. .	976
. .	. .	. .	. .	072	. .	. .	. .	071	. .	060	. .	. .	. .	082	. .	070
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	160	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	404	. .
. .	. .	. .	. .	. .	. .	975	. .	. .	. .	. .	. .	. .	. .	. .	. .	978
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	260
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	408
. .	. .	. .	. .	259	. .	258	. .	256	.	239	. .	. .	. .	255	. .	255
. .	. .	. .	. .	. .	. .	324	. .	. .	. .	. .	. .	. .	. .	. .	. .	327
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	696
. .	. .	. .	560	. .	. .	. .	. .	. .	. .	. .	564	. .	. .	. .	557	. .
. .	. .	. .	301	. .	. .	. .	. .	. .	. .	. .	277	. .	. .	. .	274	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	296

	Intensity in Arc	Intensity in Sun	Nature in Arc	Kind of Standard		Pl 20 ⊙ 62 I ⊙ 31 II	⊙ M 44 II, M 29 III, M 22 IV								⊙ M 48 II, M 32 III, M 24 IV				Substandard
						J c ⊙	Ca J c M	Sr J c M	Fe J c M	Si J c M	Si J a M	Si J a M	Si J a M	Ba J c M	Mg J c M	Si b_2 J b M	Si c_3 J c M	Ni J c M	
Fe	5	. .	. .	M	3017	. .	747	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	5	. .	. .	M	3019	. .	109	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	3019	. .	752	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	10	. .	R	M	3020	. .	610	600	619	613	. .	. .	. .	. .	. .	. .	. .	. .	*610*
Fe	25	. .	R	M	3020	. .	760	754	765	761	. .	. .	. .	765	. .	. .	. .	. .	*761*
Fe	15	. .	R	M	3021	. .	194	186	193	198	. .	. .	. .	201	. .	. .	. .	. .	*194*
Fe	7	7	R	M	3024	. .	154	. .	165	156	. .	. .	. .	. .	. .	. .	. .	. .	. .
	. .	5	. .	⊙′	3024	462	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	. .	4	. .	⊙′	3025	387	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	10	10	R	M	3025	. .	. .	. .	973	965	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	3027	. .	245	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	. .	4	. .	⊙	3035	848	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	15	15	R	M	3037	. .	511	504	520	510	. .	. .	. .	. .	. .	. .	. .	. .	*509*
Ca	15	4	R	⊙, M	3044	115	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Mn	10	3	R	⊙′	3044	687	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	. .	3	. .	⊙′	3046	778	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	20	20	R	M	3047	. .	727	716	740	729	. .	. .	. .	. .	. .	. .	. .	. .	*728*
	. .	d $^{2}_{3}$	. .	⊙″	3050	215	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe?	. .	3	. .	⊙′	3053	172	. .	. .		. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	. .	d $^{3}_{4}$	. .	⊙′	3053	527	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	. .	d? 5	. .	⊙″	3055	817	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	10	10	R	M	3057	. .	566	. .	590	572	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	10	10	R	M	3059	. .	204	190	224	209	. .	. .	. .	. .	202	. .	196	. .	*204*
	. .	3	. .	⊙′	3061	098	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Co	8	3	R	⊙″	3061	930	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	10	10	R	M	3067	. .	363	350	396	374	. .	. .	. .	. .	. .	. .	352	. .	*367*
Ti	6	8	. .	M	3075	. .	330	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	10	10	R	M	3075	. .	835	. .	879	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	2	. .	M	3077	. .	. .	. .	216	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	. .	4	. .	⊙	3077	292	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe?	. .	4	. .	⊙″	3078	142	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ti	4	6	. .	M	3078	. .	765	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Mn	7	2	. .	⊙″	3079	724	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	. .	5	. .	⊙″	3080	863	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Al	20	7	R	M	3082	. .	269	. .	. .	. .	. .	. .	. .	. .	294	261	270	276	. .

☉ M 32 II												Sub-stand-ard	☉ 48 II, M 32 III, M 24 IV		Mean	
Prd J b ☉	Prd J b M	Ca J c ☉	Ca J c M	Ba J b ☉	Ba J b M	Sr J b ☉	Sr J b M	Co J b ☉	Co J b M	Si J b ☉	Si J b M	M	C J b M	Sn J c M	☉	M
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	747
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	109
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	752
..	610	..	610	..	619	..	618	..	600	..	612	..	..	..	..	611
..	762	..	765	..	764	..	748	..	752	..	758	*	..	..	..	759
..	192	..	192	..	194	..	179	..	185	..	184	..	..	..	..	191
..	..	..	142	..	..	..	..	..	..	..	..	..	..	..	..	154
491	..	464	..	..	..	..	..	481	..	..	..	..	..	..	475	..
417	..	388	..	..	..	..	..	384	..	..	..	..	..	..	394	..
..	..	..	958	..	944	..	..	..	..	..	951	..	..	..	..	958
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	245
865	..	842	..	..	..	..	..	846	..	..	..	..	..	..	850	..
493	..	..	495	..	496	..	..	490	..	..	499	..	..	..	492	505
130	..	..	..	..	..	..	..	113	114	..	..	..	..	..	119	114
682	..	680	..	..	..	..	..	681	..	..	..	..	..	..	683	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	778	..
..	727	..	718	..	703	..	705	..	..	..	718	..	..	..	..	720
220	..	200	..	..	..	..	..	212	..	..	..	..	..	..	212	..
172	..	170	..	..	..	..	..	178	..	..	..	..	..	..	173	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	527	..
828	..	816	..	..	..	..	..	824	..	..	..	..	..	..	821	..
..	..	..	554	..	553	..	510	..	554	..	..	..	..	..	..	557
..	205	..	193	..	190	..	210	..	179	..	194	..	..	..	..	200
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	098	..
937	..	920	..	..	..	..	..	933	932	..	..	..	..	..	930	932
..	..	..	346	..	362	..	..	..	..	..	..	..	..	..	..	363
..	..	..	347	..	..	..	..	..	..	..	..	..	..	..	..	339
..	..	..	832	..	..	..	..	..	..	..	..	..	..	..	..	849
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	216
309	..	296	..	..	..	319	..	299	..	..	..	..	..	..	303	..
156	..	140	..	..	..	157	..	146	..	..	..	..	..	..	148	..
..	..	..	753	..	..	..	..	..	..	..	..	..	..	..	..	759
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	724	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	863	..
..	274	..	274	..	269	..	285	..	261	..	267	*273*	267	270	..	272

	Intensity in Arc	Intensity in Sun	Nature in Arc	Kind of Standard		Pl 20 ⊙ 62 I ⊙ 31 II	Pl 12 ⊙ 42 III ⊙ 33 IV	Pl 13 ⊙ 42 III ⊙ 33 IV	Pl 14 ⊙ 33 IV	Substandard	⊙ M 44 II, M 29 III, M 22 IV							
						J c ⊙	R a ⊙	R a ⊙	R a ⊙		Ca J c M	Sp J c M	Fe J c M	Si J c M	Si J a M	Si J a M	Si J a M	Ba J c M
Fe	6	7	R	M	3083	. .	. .	. .	. .	. .	854	. .	. .	. .	. .	. .	. .	. .
	. .	4	. .	⊙″	3086	891	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ti	8	8	R	M	3088	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Al	20	10	R	M	3092	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Al	4	2	. .	M	3092	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	. .	2	. .	⊙′	3094	730	. .	747	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	1	3	. .	⊙′	3095	000	. .	015	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	4	6	. .	M	3100	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe (Mn)	4	6	. .	M	3100	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	6	6	. .	M	3100	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ni	20	8	R	M	3101	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ni	10	6	R	M	3101	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	. .	2	. .	⊙	3106	. .	. .	677	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Cr ?	. .	3	. .	⊙′	3109	434	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	2	. .	⊙″	3115	. .	. .	170	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Va	7	5	. .	⊙″	3121	259	. .	271	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Zr	3	1	. .	⊙′	3129	879	860	887	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ni	10	8	R	M	3134	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Co	4	2	. .	⊙′	3137	439	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	3	. .	⊙′	3140	865	865	877	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	2	. .	⊙′	3153	861	863	887	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ca	. .	8	. .	M	3158	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Mn	. .	1	. .	⊙′	3167	283	286	302	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	. .	5	. .	⊙″	3172	175	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
La ?	1	1	. .	⊙′	3176	096	097	120	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Cr ?	4	4	. .	⊙′	3188	154	163	181	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ni	3	3	. .	M	3195	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ti	10	4	R	⊙″	3200	024	022	049	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	5	5	. .	M	3214	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ti	4	3	. .	⊙″	3218	376	385	406	395	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	6	. .	⊙′	3219	697	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	6	. .	⊙′	3219	909	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .

⊙ M 48 II, M 32 III, M 24 IV				Sub-stand-ard	⊙ M 32 II												Sub-stand-ard	M 32 III, M 24 IV		Mean	
Mg J c M	Si J b M	Si J c M	Ni J c M	⊙	Prd J b ⊙	Prd J b M	Ca J c ⊙	Ca J c M	Ba J b ⊙	Ba b J M	Sp J b ⊙	Sp J b M	Co J b ⊙	Co J b M	Si J b ⊙	Si J b M		C 48 J b M	Sn 48 J c M	⊙	M
. .	. .	851	. .	. .	. .	. .	. .	841	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	849
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	891	. .
. .	. .	. .	. .	. .	. .	. .	. .	137	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	137
. .	816	826	. .	. .	. .	830	. .	827	. .	823	. .	823	. .	819	. .	825	*824*	827	820	. .	824
. .	. .	949	. .	. .	. .	975	. .	970	. .	955	. .	971	. .	952	. .	. .	. .	. .	. .	. .	962
. .	. .	. .	. .	*738*	737	. .	729	. .	. .	. .	751	. .	739	. .	741	. .	. .	. .	. .	739	. .
. .	. .	. .	. .	. .	006	. .	998	. .	. .	. .	002	. .	010	. .	992	. .	. .	. .	. .	003	. .
. .	. .	. .	. .	. .	. .	. .	. .	076	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	064
. .	. .	051	. .	. .	. .	. .	. .	421	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	415
. .	. .	408	. .	. .	. .	. .	. .	783	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	779
. .	. .	775	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	672	. .	. .	. .	. .	. .	. .	673
. .	. .	. .	673	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	994	. .	. .	. .	. .	. .	. .	994
. .	. .	. .	993	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	677	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	434	. .
. .	. .	. .	. .	. .	. .	. .	150	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	160	. .
. .	. .	. .	. .	*265*	273	. .	267	. .	299	. .	278	. .	276	. .	. .	. .	. .	. .	. .	275	. .
. .	. .	. .	. .	*876*	. .	. .	880	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	882	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	223
. .	. .	. .	223	. .	. .	. .	443	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	441	. .
. .	. .	. .	. .	*868*	. .	. .	867	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	869	. .
. .	. .	. .	. .	*868*	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	870	. .
. .	. .	. .	. .	. .	. .	. .	988	994	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	988	994
. .	. .	. .	. .	*288*	. .	. .	290	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	290	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	175	. .
. .	. .	. .	. .	*102*	. .	. .	104	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	104	. .
. .	. .	. .	. .	*163*	. .	. .	157	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	164	. .
. .	. .	. .	. .	. .	. .	. .	702	729	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	702	729
. .	. .	. .	. .	*030*	. .	. .	034	040	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	032	040
. .	. .	152	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	152
. .	. .	. .	. .	*390*	. .	. .	390	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	390	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	697	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	909	. .

	Intensity in Arc	Intensity in Sun	Nature in Arc	Kind of Standard		Pl 20 ⊙ 62 I ⊙ 31 II	Pl. 13 ⊙42 III ⊙32 IV	Pl. 14 ⊙32 IV	Pl. 15 ⊙44 III ⊙33 IV	Pl. 1 ⊙45 III ⊙34 IV	Sub-standard	⊙ M 48 II, M 32 III, M 24 IV				⊙ M 32 II			
						J c ⊙	R a ⊙	R a ⊙	R a ⊙	R a ⊙		Mg J c M	Si b J b M	Si c J c M	Ni J c M	Prd J b ⊙	Prd J b M	Ca J c ⊙	Ca J c M
Fe–	6	d$\frac{5}{7}$	. .	⊙	3222	. .	. .	. .	. .	. .	. .	. .	. .	203	. .	. .	. .	203	190
Ti	6	4	. .	⊙′′	3224	354	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	381	. .
Fe	8	8	. .	M	3225	. .	. .	. .	. .	. .	. .	. .	. .	898	. .	. .	. .	923	915
Ti–	5	5	. .	⊙′′	3231	421	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ti	6	4	. .	M	3232	393	414	405	. .	. .	*404*	. .	. .	. .	. .	404	. .	403	. .
Ti	10	8	R	M	3236	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	697	696
–Fe	. .	6	. .	⊙′′	3246	110	138	125	. .	. .	*124*	. .	. .	. .	. .	121	. .	121	. .
Cu	100	9	R	M	3247	. .	. .	. .	. .	. .	. .	. .	660	667	674	674	665	675	670
Mn, Ti, Fe	4,3,1	4	. .	⊙′	3260	373	. .	392	. .	. .	. .	. .	. .	. .	. .	389	. .	379	. .
Va	10	4	. .	⊙′′	3267	850	. .	842	. .	. .	. .	. .	. .	. .	. .	836	. .	837	. .
Cu	100	6	R	⊙′′	3274	. .	. .	. .	. .	. .	. .	100	066	074	083	090	098	090	089
Ti	6	5	. .	⊙′′	3287	. .	. .	796	. .	. .	. .	. .	. .	. .	. .	785	. .	786	. .
Fe– (Co,Ti)	5,4,7	5	. .	⊙′′	3292	. .	. .	176	176	. .	. .	. .	. .	. .	. .	171	. .	166	. .
Mn, Di	3, 2	4	. .	⊙′′	3295	. .	. .	942	968	. .	. .	. .	. .	. .	. .	. .	. .	952	. .
Na	10	6	R	⊙′′	3302	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	507	. .	503	498
Na	9	5	R	M	3303*	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	106	. .	109	107
–Fe	. .	d$\frac{4}{2}$	. .	⊙′	3303	. .	. .	651	662	. .	. .	. .	. .	. .	. .	642	. .	644	. .
Fe	10	7	. .	M	3306	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	124	. .	119	119
Fe	10	7	. .	M	3306	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	477	. .	472	481
Mn– (Co,Ti)	2,3,6	d 5	. .	⊙′′	3308	. .	. .	927	937	. .	. .	. .	. .	. .	. .	926	. .	925	. .
Ti	5	5	. .	⊙′′	3318	. .	. .	165	167	. .	. .	. .	. .	. .	. .	165	. .	159	. .
Fe	2	3	. .	⊙′	3331	. .	. .	. .	. .	717	. .	. .	. .	. .	. .	. .	. .	746	. .
Cr–Fe	3, 3	d$\frac{3}{3}$	. .	⊙′	3348	. .	. .	. .	013	994	. .	. .	. .	. .	. .	. .	. .	021	. .
Fe	2	2	. .	⊙′	3351	. .	. .	. .	880	860	. .	. .	. .	. .	. .	. .	. .	885	. .
Zr	4	1	. .	⊙′′	3356	. .	. .	. .	. .	211	. .	. .	. .	. .	. .	. .	. .	231	. .
Ti–Ti	5, 5	d$\frac{3}{3}$	. .	⊙′′	3377‡	. .	. .	. .	670	653	*661*	. .	. .	. .	. .	. .	. .	679	. .
Fe	2	2	. .	⊙′′	3389	. .	. .	. .	886	881	*883*	. .	. .	. .	. .	916	. .	894	. .
Co–Ti	10	d	R	⊙′	3405	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	294	. .	. .	. .
Fe	2	1	. .	⊙′	3406	. .	. .	. .	577	566	*571*	. .	. .	. .	. .	609	. .	583	. .
Fe	5	4	. .	⊙′	3406	. .	. .	. .	953	940	*946*	. .	. .	. .	. .	980	. .	958	. .
Fe?	. .	2	. .	⊙′′	3425	. .	. .	. .	721	717	*719*	. .	. .	. .	. .	. .	. .	. .	. .
Fe	6	5	. .	M	3427§	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	20	20	R	M	3440†	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	10	10	. .	M	3441†	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .

* Red component of a double with a Zn line between. Another Zn line at about 3302.7 in the solar spectrum.

† These are part of a group of five lines.

‡ A nebulous line of B very wide comes here.

§ Red component of double, the other line being also Fe.

☉ M 32 II								Sub-standard.	M 32 III, M 24 IV		☉ M 36 II, M 24 III														Mean	
Ba J b ☉	Ba J b M	Sr J b ☉	Sr J b M	Co J b ☉	Co J b M	Si J b ☉	Si J b M		C 48 J b M	Sn 48 J c M	Fe ☉	Fe M	Th ☉	Th M	Si G c ☉	Si G c M	Si F c ☉	Si F c M	Ba b ☉	Ba b M	Sr b ☉	Sr b M	Ca C. curve ☉	Ca C. curve M	☉	M
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	203	197
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	368	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	923	907
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	421	. .
409	. .	396	. .	408	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	404	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	697	696
124	. .	113	. .	137	. .	127	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	124	. .
691	678	677	669	682	673	. .	681	*673*	673	675	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	680	671
382	. .	374	. .	395	. .	391	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	384	. .
841	. .	831	. .	837	. .	835	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	839	. .
091	083	080	080	107	113	. .	114	*090*	091	088	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	092	090
794	. .	790	. .	791	. .	795	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	791	. .
169	. .	175	. .	182	. .	177	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	174	. .
958	. .	965	. .	956	. .	960	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	957	. .
495	. .	494	. .	508	. .	. .	509	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	501	504
093	. .	100	. .	113	. .	. .	130	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	107	119
645	. .	646	. .	647	. .	647	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	648	. .
116	. .	114	. .	110	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	117	119
463	. .	463	. .	482	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	471	481
928	. .	921	. .	929	. .	931	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	928	. .
161	. .	157	. .	164	. .	169	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	163	. .
744	. .	743	. .	746	. .	752	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	741	. .
014	. .	007	. .	008	. .	022	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	011	. .
875	. .	874	. .	881	. .	884	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	877	. .
220	. .	219	. .	222	. .	229	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	222	. .
670	. .	663	. .	665	. .	667	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	667	. .
884	. .	886	. .	872	. .	878	. .	. .	. .	. .	892	913	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	883	. .	887	913
255	. .	270	. .	254	255	264	. .	. .	. .	. .	. .	. .	271	. .	269	. .	300	. .	268	. .	. .	. .	. .	. .	272	255
566	. .	571	. .	578	. .	. .	. .	. .	. .	. .	582	602	583	. .	580	. .	608	. .	581	. .	. .	. .	575	. .	581	602
945	. .	953	. .	946	. .	. .	. .	. .	. .	. .	952	965	955	. .	953	. .	980	. .	949	. .	. .	. .	945	. .	955	965
. .	. .	723	. .	717	. .	. .	. .	. .	. .	. .	721	. .	722	. .	720	. .	726	. .	721	. .	725	. .	716	. .	721	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	282	281	. .	. .	. .	277	. .	. .	. .	. .	. .	. .	. .	. .	282	279
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	760	760	. .	758	758	761	761	759	. .	749	. .	755	758	750	759	756
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	129	124	. .	. .	140	145	139	139	. .	134	. .	134	132	133	135	135

	Intensity in Arc	Intensity in Sun	Nature in Arc	Kind of Standard		Pl 15 ⊙ 44 III ⊙ 33 IV	Pl 1 ⊙ 45 III ⊙ 34 IV	Pl 2 ⊙ 48 III ⊙ 36 IV	Substandard	⊙ M 36 II, M 24 III							
						R a ⊙	R a ⊙	R a ⊙		Fe J c ⊙	Fe J c M	Th J c ⊙	Th J c M	Si G J a ⊙	Si G J a M	Si G J a ⊙	Si G J a M
Fe	8	8	R	M	3444	. .	. .	. .	. .	029	029	. .	. .	. .	. .	. .	. .
Co	4	4	R	⊙″	3455	390	383	. .	*386*	379	. .	383	. .	. .	. .	. .	. .
Sr?	8	3	. .	⊙″	3464	613	612	. .	*612*	604	. .	610	. .	. .	. .	. .	. .
Co – Fe	7,10	10 d	R, R	M	3466** or 5	. .	. .	. .	. .	980	010	. .	017	. .	. .	. .	. .
Fe	10	10	R	M	3475††	. .	. .	. .	. .	585	597	. .	605	. .	. .	. .	. .
Fe	7	8 d	R	M	3476††	. .	. .	. .	. .	830	846	. .	. .	. .	. .	. .	. .
Co, Fe, Ni	2,3,2	4	. .	⊙″	3478 or 7	014	998	001	*004*	995	. .	003	. .	. .	. .	. .	. .
Ni	3	5	R	⊙′	3486	. .	048	045	*046*	030	. .	036	. .	. .	. .	. .	. .
Fe	10	10	R	M	3490*	. .	. .	. .	. .	716	718	. .	732	. .	. .	. .	. .
Co –	4	4	R	⊙″	3491	. .	. .	470	. .	459	. .	467	. .	. .	. .	. .	. .
Fe	5	5	. .	M	3497†	. .	. .	. .	. .	264	266	. .	. .	. .	. .	. .	. .
Fe –	6	d_3^7	R	M	3497‡	. .	. .	. .	. .	981	986	. .	. .	. .	. .	. .	. .
Fe	2	3	. .	⊙″	3500	. .	. .	710	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ni	7	5	R	⊙″	3500 or 1	. .	. .	. .	. .	991	. .	001	. .	. .	. .	. .	. .
Ti	5	4	. .	⊙′	3510‡‡	. .	. .	983	. .	981	. .	982	. .	. .	. .	. .	. .
Fe	7	6	R	M	3513‡	. .	. .	. .	. .	952	986	. .	. .	. .	. .	. .	. .
Co	6	5	R	⊙″	3518	. .	. .	486	. .	481	. .	483	. .	489	. .	. .	. .
Th	100	. .	R	M	3519	. .	. .	. .	. .	. .	. .	. .	342	. .	. .	. .	. .
Fe	5	7	R	M	3521	. .	. .	. .	. .	398	407	401	397	408	407	405	409
Th	20	. .	R	M	3529	. .	. .	. .	. .	. .	. .	. .	547	. .	. .	. .	. .
Fe	3	5	. .	⊙″	3540	. .	. .	266	. .	261	. .	261	. .	261	. .	. .	. .
Va	1	4	. .	⊙″	3545	. .	. .	332	. .	330	. .	329	. .	. .	. .	. .	. .
Y	. .	. .	. .	⊙″	3549	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	2	3	. .	⊙″	3550 or 49	. .	. .	013	. .	. .	. .	998	. .	. .	. .	. .	. .
Fe	9	8	R	⊙	3558	. .	. .	. .	. .	659	671	661	673	. .	. .	. .	. .
Ti – Fe	2,1	d_2^1	. .	⊙″	3564	. .	. .	683	. .	675	. .	674	. .	679	. .	678	. .
Fe	10	12	R	M	3565	. .	. .	. .	. .	523	519	526	526	. .	. .	. .	. .
Fe	20	20	R	M	3570§	. .	. .	. .	. .	223	250	217	245	. .	. .	. .	. .
Fe	10	10	. .	M	3570	. .	. .	. .	. .	402	412	. .	. .	. .	. .	. .	. .
Fe	30	40	R	M	3581	. .	. .	. .	. .	338	340	340	344	. .	339	. .	340
Fe?	2	4	. .	⊙″	3583	. .	. .	484	. .	477	. .	475	. .	480	. .	483	. .
Y	. .	. .	. .	M	3584	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
C	. .	2	. .	M	3586‖ or 5	. .	. .	. .	. .	. .	029	. .	984	. .	. .	. .	. .
C	. .	. .	. .	M	3586	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
C	. .	3	. .	M	3590¶	. .	. .	. .	. .	. .	556	. .	500	. .	. .	. .	. .

* Co. line near this to the red.
† Red component of a double.
‡ Violet component of a double.
§ Probably several lines mixed together in solar spectrum.
‖ First line in the second head of the carbon band.
¶ First line in the first head of the carbon band.
** The metal measured was Fe.
†† Strongest line of group.
‡‡ A strong compound Bi line comes here also.

⊙ M 36 II, M 24 III												⊙ M 37 III		⊙ M 38 II		Mean	
Si G J c ⊙	Si G J c M	Si F J a ⊙	Si F J a M	Si F J c ⊙	Si F J c M	Ba J c ⊙	Ba J c M	Sr J c ⊙	Sr J c M	Ca J c ⊙	Ca J c M	Ca J c ⊙	Ca J c M	Ni J c ⊙	Ni J c M	⊙	M
039	034	. .	. .	034	028	. .	014	. .	015	025	023	. .	. .	. .	. .	032	024
385	. .	. .	. .	382	. .	383	. .	394	. .	378	. .	. .	. .	. .	. .	384	. .
610	. .	. .	. .	608	. .	606	. .	. .	. .	609	. .	. .	. .	. .	. .	609	. .
012	018	. .	. .	. .	009	. .	004	. .	004	982	008	. .	. .	. .	. .	991	010
600	611	. .	. .	. .	599	. .	594	. .	608	598	601	. .	. .	. .	. .	594	602
831	861	. .	. .	. .	856	. .	845	. .	834	. .	. .	. .	. .	. .	. .	831	848
002	. .	. .	. .	001	. .	999	. .	993	. .	001	. .	. .	. .	. .	. .	001	. .
036	. .	. .	. .	036	. .	029	. .	029	. .	039	. .	. .	. .	. .	. .	036	. .
726	728	. .	. .	. .	726	. .	718	. .	719	721	726	. .	. .	. .	. .	721	724
466	. .	. .	. .	462	. .	453	. .	469	. .	469	. .	. .	. .	. .	. .	464	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	264	266
998	999	. .	. .	992	. .	. .	994	. .	985	992	993	. .	. .	. .	. .	991	991
. .	. .	. .	. .	712	. .	. .	. .	711	. .	713	. .	. .	. .	. .	. .	712	. .
002	. .	. .	. .	997	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	993	. .
992	. .	. .	. .	988	. .	992	. .	988	. .	992	. .	. .	. .	. .	. .	987	. .
966	976	. .	. .	. .	. .	. .	. .	924	. .	. .	. .	. .	. .	. .	. .	947	981
493	. .	484	. .	489	. .	489	. .	487	. .	493	. .	. .	. .	. .	. .	487	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	342
408	416	. .	. .	. .	. .	. .	420	. .	. .	. .	. .	. .	. .	. .	. .	404	409
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	547
262	. .	262	. .	270	. .	272	. .	277	. .	263	. .	. .	. .	. .	. .	266	. .
334	. .	. .	. .	339	. .	. .	. .	. .	. .	335	. .	. .	. .	. .	. .	333	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	145	147	. .	. .	145	147
007	. .	. .	. .	013	. .	010	. .	. .	. .	002	. .	998	. .	. .	. .	006	. .
671	679	. .	. .	687	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	670	674
681	. .	682	. .	687	. .	687	. .	682	. .	685	. .	664	. .	. .	. .	680	. .
532	535	. .	. .	. .	. .	. .	542	. .	529	532	530	. .	. .	. .	. .	528	530
227	254	. .	. .	. .	260	. .	265	. .	255	234	250	. .	241	. .	. .	225	253
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	402	412
344	348	. .	342	352	. .	. .	. .	. .	348	343	346	346	345	. .	. .	344	344
485	. .	482	. .	487	. .	489	. .	488	. .	479	. .	481	. .	. .	. .	483	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	662	662	. .	. .	662	662
. .	974	. .	. .	. .	008	. .	981	. .	983	. .	000	. .	973	. .	. .	. .	992
. .	049	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	033	. .	. .	. .	041
. .	544	. .	. .	. .	540	. .	. .	. .	504	. .	512	. .	507	. .	. .	. .	523

	Intensity in Arc	Intensity in Sun	Nature in Arc	Kind of Standard		Pl 2 ⊙48 III ⊙36 IV	Pl 3 ⊙49 III ⊙37 IV	Pl 4 ⊙50 III ⊙38 IV	Substandard	⊙ M 36 II, M 24 III							
						R a ⊙	R a ⊙	R a ⊙	⊙	Fe J c ⊙	Fe J c M	Th J c ⊙	Th J c M	Si G J a ⊙	Si G J a M	Si G J a ⊙	Si G J a M
Fe	5	4	. .	⊙″	3597	190	. .	. .	. .	188	. .	188	. .	189	. .	191	. .
Ytt	10	4	. .	⊙″ M	3600	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ytt	6	3	. .	⊙	3602	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Cr	20	3	R	M	3605†	. .	. .	. .	. .	478	. .	. .	. .	. .	. .	. .	. .
Fe	7	7	. .	M	3605†	. .	. .	. .	. .	626	623	. .	. .	. .	. .	. .	. .
Fe	7	6?	. .	M	3606‡	. .	. .	. .	. .	829	832	. .	. .	. .	. .	. .	. .
Fe	15	15	R	M	3609	. .	. .	. .	. .	009	009	012	013	016	011	016	011
Ytt	7	3	. .	M	3611	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	4	4	. .	⊙′	3612	216	217	. .	*216*	210	237	216	. .	217	. .	216	. .
Ca–Fe	4	d^2_3	. .	M	3617§	. .	. .	. .	. .	920	939	. .	. .	. .	. .	. .	. .
Fe	20	20	R	M	3618	. .	. .	. .	. .	918	917	918	918	925	918	923	920
Ytt	3	1	. .	M	3621	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	4	4	. .	⊙	3621	. .	. .	. .	. .	599	613	. .	. .	. .	. .	. .	. .
Fe	4	4	. .	⊙ M	3622	. .	. .	. .	. .	143	156	. .	. .	. .	. .	. .	. .
Fe	4	4	. .	⊙″	3623	330	331	. .	*330*	320	338	330	. .	332	. .	336	. .
Fe	2	3 d?	. .	⊙″	3623	599	608	. .	*604*	595	. .	597	. .	. .	. .	. .	. .
Ytt	3	2	. .	M	3628	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	20	20	R	M	3631	. .	. .	. .	. .	613	611	615	612	622	615	620	612
Ytt	5	d	. .	M	3633‖	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ti	10	3	R	⊙′	3635	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	4	4	. .	M	3638	. .	. .	. .	. .	435	454	. .	. .	. .	. .	. .	. .
Pb	50	1	R	M	3639*	. .	. .	. .	. .	. .	. .	. .	726	. .	725	.	727
Cr–Fe	2,5	d^1_4	. .	⊙′	3640§	536	534	. .	*535*	533	545	537	. .	534	. .	535	. .
Fe	10	10	R	M	3647	. .	. .	. .	. .	993	989	994	994	992	986	993	989
Co	8	3	R	⊙″	3652	689	693	. .	*691*	. .	. .	. .	. .	. .	. .	. .	. .
Ti	10	4	R	⊙	3653	. .	. .	. .	. .	642	. .	636	. .	634	. .	639	. .
Mn–Fe	2,2	1,2	. .	⊙″	3658	. .	684	. .	. .	686	. .	. .	. .	. .	. .	. .	. .
Fe	5	3	. .	⊙″	3667	400	398	. .	. .	395	. .	391	. .	395	. .	393	. .
Fe	7	7	R	M	3680	. .	. .	. .	. .	063	066	. .	. .	063	061	061	059
Co, Fe, Va	9,3,4	6	. .	⊙″	3683§	. .	200	197	. .	203	209	203	. .	198	. .	200	. .
Pb	60	½	R	M	3683	. .	. .	. .	. .	. .	628	. .	619	. .	617	. .	621
Fe	5	6	. .	⊙″	3684	. .	256	255	. .	260	268	258	. .	257	. .	258	. .
Fe	10	8	R	M	3687	. .	. .	. .	. .	606	607	. .	. .	603	602	605	606
Fe	5	5	. .	⊙″	3695	. .	197	192	. .	194	208	194	. .	. .	. .	. .	. .

* In solar spectrum this is the red component of a double, the other being Co.

† Solar line is a group of four lines, the extreme line to red being Fe.

‡ Red component of an equal double.

§ Metal measured was Fe.

‖ Red component of double.

⊙ M 36 II, M 24 III												⊙ M 37 III		⊙ M 38 II		Mean	
Si G J c ⊙	Si G J c M	Si F J a ⊙	Si F J a M	Si F J c ⊙	Si F J c M	Ba J c ⊙	Ba J c M	Sr J c ⊙	Sr J c M	Ca J c ⊙	Ca J c M	Ca J c ⊙	Ca J c M	Ni J c ⊙	Ni J c M	⊙	M
194	. .	190	. .	195	. .	201	. .	193	. .	. .	. .	191	. .	196	. .	192	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	880	884	. .	. .	880	884
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	061	065	. .	. .	061	065
487	497	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	483	497
643	618	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	635	621
832	839	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	831	836
013	018	015	012	019	022	028	024	. .	015	014	013	012	012	. .	. .	015	015
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	193	196	. .	. .	193	196
218	. .	216	. .	220	. .	223	. .	221	. .	214	. .	210	. .	219	. .	217	237
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	920	939
926	923	923	921	930	931	936	931	. .	922	922	920	923	921	. .	. .	924	922
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	122	096	. .	. .	122	096
612	619	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	606	616
151	165	. .	. .	149	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	147	161
331	. .	332	. .	336	. .	335	. .	335	. .	331	. .	336	. .	332	. .	332	338
600	. .	. .	. .	603	. .	612	. .	602	. .	. .	. .	600	. .	599	. .	603	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	853	853	. .	. .	853	853
625	621	616	614	625	627	624	626	. .	618	615	612	610	613	. .	. .	619	616
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	259	277	. .	. .	259	277
. .	. .	. .	. .	. .	. .	. .	609	. .	617	. .	. .	616	618	. .	. .	616	615
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	435	454
. .	732	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	728
537	. .	540	. .	545	. .	538	. .	535	. .	534	. .	543	. .	531	. .	536	545
983	990	995	992	005	007	010	007	993	994	994	. .	991	997	. .	. .	995	995
. .	. .	. .	. .	. .	. .	. .	. .	688	. .	690	. .	698	. .	. .	. .	692	. .
635	. .	644	. .	. .	. .	. .	. .	. .	636	640	642	. .	. .	. .	. .	639	639
687	. .	. .	. .	701	. .	. .	. .	685	. .	689	. .	. .	. .	681	. .	688	. .
392	. .	398	. .	414	. .	. .	. .	395	. .	397	. .	407	. .	389	. .	397	. .
062	064	066	059	073	074	. .	. .	. .	060	058	062	. .	. .	. .	. .	064	064
202	. .	204	. .	212	. .	198	. .	. .	. .	203	. .	215	. .	197	. .	202	209
. .	624	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	622
261	. .	259	. .	269	. .	258	. .	259	. .	259	. .	263	. .	257	. .	259	268
604	609	. .	. .	618	618	. .	615	. .	600	605	605	. .	. .	. .	. .	607	609
193	. .	. .	. .	195	. .	191	. .	194	. .	195	. .	202	. .	189	. .	194	208

	Inten sity in Arc	Inten-sity in Sun	Na-ture in Arc	Kind of Stand-ard		Pl 3 ⊙ 49 III ⊙ 37 IV	Pl 4 ⊙ 50 III ⊙ 38 IV	Pl 5 ⊙ 52 III ⊙ 39 IV	Pl 6 ⊙ 52 III ⊙ 39 IV	⊙ M 40 II, M 27 III				Sub-Stand-ard.	○ M 36 II, M 24 III			
						R a ⊙	R a ⊙	R a ⊙	R a ⊙	Co J c ⊙	Co J c M	Zr J c ⊙	Zr J c M		Fe J c ⊙	Fe J c M	Th J c ⊙	Th J c M
Fe	7	8	R	M	3705§	. .	. .	. .	. .	. .	. .	. .	. .	. .	709	714	711	715
Fe	. .	5	. .	⊙′	3707	182	181	. .	. .	. .	. .	. .	. .	. .	186	201	187	. .
Fe	10	10	R	M	3709	. .	. .	. .	. .	. .	. .	. .	. .	. .	394	393	395	399
Y	. .	. .	. .	M	3710	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	6	7	. .	⊙″	3716	581	575	. .	. .	. .	. .	. .	. .	. .	586	601	586	. .
Fe	50	50	R	M	3720	. .	. .	. .	. .	. .	. .	. .	. .	. .	088	082	083	081
Ni – Fe, Ti	4,8,5	d 10	. .	M	3722*	. .	. .	. .	. .	. .	. .	. .	. .	. .	692	713	687	710
Fe	6	7	R	M	3727	. .	. .	. .	. .	. .	. .	. .	. .	. .	759	766	765	765
Fe	5	5	. .	⊙″	3732	550	536	. .	. .	. .	. .	. .	. .	. .	540	549	541	. .
Fe	6	7	R	M	3733	. .	. .	. .	. .	. .	. .	. .	. .	. .	466	471	466	470
Fe	50	60	R	M	3735	. .	. .	. .	. .	. .	. .	. .	. .	. .	014	013	012	009
Ni	6	. .	. .	⊙	3736	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ca, Mn	4,2	8	R	M	3737	. .	. .	. .	. .	. .	. .	. .	. .	. .	102	095	. .	. .
Fe	25	30	R	M	3737	. .	. .	. .	. .	. .	. .	. .	. .	. .	284	276	282	277
Ti, Fe, Cr	3,5,3	t 2,6,2	. .	M	3743‖	. .	. .	. .	. .	. .	. .	. .	. .	. .	496	499	. .	. .
Fe	8	10	R	M	3745†	. .	. .	. .	. .	. .	. .	. .	. .	. .	697	697	693	706
Fe	6	7	R	M	3746	. .	. .	. .	. .	. .	. .	. .	. .	. .	052	044	050	046
Fe –	3	d 7	. .	⊙′	3747*	. .	. .	. .	. .	. .	. .	. .	. .	. .	092	082	094	. .
Fe	9	10	R	M	3748	. .	. .	. .	. .	. .	. .	. .	. .	. .	408	407	408	408
Fe	15	20	R	M	3749	. .	. .	. .	. .	. .	. .	. .	. .	. .	631	629	631	632
	. .	d 2,1	. .	⊙	3754	661	651	. .	. .	. .	. .	. .	. .	. .	661	. .	665	. .
Fe	2	2	. .	⊙′	3756	210	207	. .	. .	. .	. .	. .	. .	. .	211	. .	213	. .
Fe	10	15	R	M	3758	. .	. .	. .	. .	. .	. .	. .	. .	. .	377	376	380	383
Fe	9	10	R	M	3763	. .	. .	. .	. .	951	947	. .	. .	. .	936	934	939	936
Fe	7	8	R	M	3767	. .	. .	. .	. .	351	352	. .	. .	. .	339	338	341	342
Fe	3	d 4	. .	⊙	3770	118	124	. .	. .	138	. .	. .	. .	. .	131	. .	134	. .
Y	. .	. .	. .	M	3774	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Th	100	. .	R	M	3775	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	869
	. .	4	. .	⊙′	3780	847	851	836	. .	848	. .	850	. .	*847*	846	. .	846	. .
Fe	. .	3	. .	⊙′	3781	333	330	324	. .	333	. .	337	. .	*332*	328	. .	332	. .
Ni	10	6	R	⊙	3783	676	680	673	. .	676	. .	681	. .	*677*	668	. .	674	. .
Fe	7	8	R	⊙	3788	. .	. .	. .	. .	. .	. .	. .	. .	. .	030	025	029	027
Fe, Cr	1.1	3	. .	⊙	3794	021	024	010	. .	013	. .	013	. .	*017*	012	. .	012	. .
Fe	8	8	. .	M	3795‡	. .	. .	. .	. .	151	. .	150	146	. .	146	154	151	143

* The metallic line measured was Fe.

† Solar line mixed. Co line near to violet.

‡ V line very near to violet.

§ Violet component of double.

‖ Metal measured was Fe.

⊙ M 36 II, M 24 III																⊙ M 37 III		⊙ M 38 II		Mean	
Si G J a ⊙	Si G J a M	Si G J a ⊙	Si G J a M	Si G J c ⊙	Si G J c M	Si F J a ⊙	Si F J a M	Si F J c ⊙	Si F J c M	Ba J c ⊙	Ba J c M	Sp J c ⊙	Sp J c M	Ca J c M	Ca J c M	Ca J c ⊙	Ca J c M	Ni J c ⊙	Ni J c M	⊙	M
. .	. .	. .	. .	711	723	. .	. .	720	723	. .	723	. .	702	706	708	. .	. .	. .	. .	711	715
187	. .	. .	. .	190	. .	187	. .	196	. .	180	. .	184	. .	184	. .	195	. .	182	. .	186	201
. .	. .	. .	. .	399	400	. .	. .	401	403	. .	389	. .	388	. .	. .	. .	. .	. .	. .	397	395
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	438	442	. .	. .	438	442
. .	. .	. .	. .	587	. .	. .	. .	594	. .	581	. .	583	. .	582	. .	594	. .	583	. .	585	601
091	084	087	082	088	085	081	080	090	093	080	079	. .	072	084	081	084	086	. .	. .	086	082
. .	. .	. .	. .	694	712	. .	. .	698	722	. .	715	. .	706	684	707	. .	. .	. .	. .	691	712
. .	. .	. .	. .	766	769	. .	. .	. .	. .	. .	774	. .	767	. .	. .	. .	. .	. .	. .	763	768
544	. .	. .	. .	546	. .	539	. .	547	. .	536	. .	536	. .	539	. .	549	. .	538	. .	542	549
. .	. .	. .	. .	469	469	. .	. .	. .	. .	. .	468	. .	458	. .	. .	. .	. .	. .	. .	467	467
. .	. .	. .	. .	012	016	. .	. .	018	017	013	011	. .	002	017	013	014	017	. .	. .	014	012
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	977	. .	961	. .	. .	. .	969	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	056	. .	069	067	. .	. .	075	081
. .	. .	. .	. .	285	283	. .	. .	285	286	279	275	. .	275	279	284	279	281	. .	. .	282	280
. .	. .	. .	. .	508	513	. .	. .	. .	. .	. .	509	. .	502	. .	. .	. .	. .	. .	. .	502	506
. .	. .	. .	. .	702	717	. .	. .	699	712	. .	710	. .	704	699	709	718	712	. .	. .	701	708
. .	. .	. .	. .	056	053	. .	. .	059	056	. .	044	. .	. .	054	047	. .	. .	. .	. .	054	048
. .	. .	. .	. .	095	. .	. .	. .	099	. .	088	. .	091	. .	096	. .	105	. .	094	. .	095	082
. .	. .	. .	. .	412	419	. .	. .	415	415	398	405	. .	403	407	411	415	409	. .	. .	409	410
. .	. .	. .	. .	636	640	. .	. .	636	638	628	634	. .	623	629	628	637	637	. .	. .	633	633
. .	. .	. .	. .	670	. .	. .	. .	673	. .	661	. .	660	. .	666	. .	672	. .	666	. .	664	. .
. .	. .	. .	. .	216	. .	. .	. .	216	. .	203	. .	209	. .	211	. .	217	. .	208	. .	211	. .
. .	. .	. .	. .	382	384	. .	. .	383	390	375	379	. .	373	377	371	381	385	. .	. .	379	380
. .	. .	. .	. .	944	947	. .	. .	940	942	939	940	. .	934	937	936	952	938	. .	. .	942	939
. .	. .	. .	. .	348	350	. .	. .	345	345	338	341	. .	333	339	334	347	339	. .	. .	344	342
. .	. .	. .	. .	135	. .	. .	. .	135	. .	127	. .	126	. .	128	. .	134	. .	128	. .	130	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	480	478	. .	. .	480	478
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	869
. .	. .	. .	. .	847	. .	. .	. .	848	. .	846	. .	847	. .	845	. .	843	. .	844	. .	846	. .
. .	. .	. .	. .	336	. .	. .	. .	331	. .	329	. .	332	. .	327	. .	329	. .	325	. .	330	. .
. .	. .	. .	. .	675	. .	. .	. .	670	. .	670	. .	675	. .	670	. .	678	. .	669	. .	674	. .
. .	. .	. .	. .	037	035	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	032	029
. .	. .	. .	. .	015	. .	. .	. .	014	. .	009	. .	015	. .	010	. .	017	. .	014	. .	014	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	150	148

	Intensity in Arc	Intensity in Sun	Nature in Arc	Kind of Standard		Pl 3 ⊙49 III ⊙37 IV	Pl 4 ⊙50 III ⊙38 IV	Pl 5 ⊙52 III ⊙39 IV	Pl 6 ⊙52 III ⊙39 IV	Pl 8 ⊙55 III ⊙41 IV	Pl 16 ⊙59 II ⊙39 III	Pl 17 ⊙59 II ⊙39 III	Pl 17 ⊙59 II ⊙39 III	Pl 18 ⊙59 II ⊙39 III	Sub-standard
						R a ⊙	R a ⊙	R a ⊙	R a ⊙	R a ⊙	R a ⊙	R a ⊙	R a ⊙	R a ⊙	⊙
Fe	. .	7	. .	⊙	3798	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	8	. .	⊙	3799	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	2	3	. .	⊙″	3804	154	155	147	. .	. .	. .	. .	. .	. .	. .
Fe, Di	4	6	. .	⊙″	3805	495	497	488	. .	. .	. .	. .	. .	. .	. .
Fe	15	20	R	M	3815	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	20	25	R	M	3820	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	5	6	. .	⊙′	3821	. .	328	311	312	. .	. .	. .	. .	. .	. .
Mn, Cr	5,1	5	R	⊙′	3823	. .	656	662	646	. .	. .	. .	. .	. .	. .
Fe	15	20	R	M	3826	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	8	8	R	M	3827	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Mg	5	8	R	. .	3829	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Mg	8	10	R	. .	3832	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
C	. .	5	. .	⊙	3836	. .	237	225	228	. .	. .	. .	. .	. .	. .
C	. .	6	. .	M	3836†	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Mg	50	20	R	⊙	3838	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	7	7	R	M	3840	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	4	5	. .	⊙	3843	. .	406	391	400	. .	. .	. .	. .	. .	. .
Fe	6	7	. .	⊙	3856	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	10	10	R	M	3860	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
C	. .	3	. .	⊙′	3864‡	. .	. .	. .	. .	. .	448	440	453	. .	. .
C	. .	7	. .	M	3871§	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
– V	6	3	. .	⊙	3875	. .	200	218	269	. .	234	234	236	232	*231*
C	. .	7	. .	M	3883‖	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
C	. .	. .	. .	M	3883¶	. .	. .	532	543	. .	564	565	544	570	*549*
Cr	. .	1	. .	⊙	3883	. .	. .	771	774	. .	780	784	784	778	*776*
Fe	15	9	R	. .	3886	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	4	. .	. .	3897	. .	. .	594	591	. .	608	604	609	599	*598*
Si	10	8	. .	M	3905	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	3	3	. .	⊙′	3916	. .	. .	863	865	. .	886	877	888	884	*874*
Ti	6	4	. .	⊙′	3924	. .	. .	656	665	. .	677	676	684	666	*668*
Co, Fe	1,2	4	. .	⊙′	3925	. .	. .	338	342	. .	351	348	360	340	*345*
Fe	3	4	. .	⊙	3925*	. .	. .	783	782	. .	801	798	800	792	*791*
Fe –	5	d 4,4	. .	⊙′	3926*	. .	. .	116	119	. .	134	127	132	121	*123*
Fe	10	8	R	M	3928	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ca	75	300	R	M	3933	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	3	4	. .	⊙′	3937	. .	. .	466	476	459	. .	. .	484	. .	. .
Fe, Co	4,4	5	. .	⊙	3941	. .	. .	015	022	010	034	032	032	031	*024*

* .087 apart.

† Central line of symmetrical group in carbon band.

‡ One of the lines of the carbon band.

§ Second head of carbon band.

‖ First line of first head of carbon band.

¶ Edge of first head of carbon band.

☉ M 40 II, M 27 III															Sub-stand-ard.	☉ M 36 II, M 24 III							☉ M 37 III		M 38 II		Mean	
Ca J c ☉	Ca J c M	Ca M b ☉	Co J c ☉	Co J c M	Zr J c ☉	Zr J c M	Ba J b ☉	Ba J b M	Sr J b ☉	Sr J b M	Si D J a ☉	Si D J a M	Si E J a ☉	Si E J a M	☉	Fe J c ☉	Si G J a ☉	Si F J c ☉	Ba J c ☉	Sr J c ☉	Ca J c ☉	Ca J c M	Ca J c ☉	Ca J c M	Ni J c ☉	Ni J c M	☉	M
. .	. .	. .	659	. .	664	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	662	. .
. .	. .	. .	698	. .	697	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	698	. .
. .	. .	. .	149	. .	159	. .	. .	. .	. .	. .	. .	. .	. .	. .	*153*	152	156	153	156	156	155	. .	149	. .	155	. .	153	. .
. .	. .	. .	482	. .	490	. .	471	. .	. .	. .	. .	. .	. .	. .	*487*	485	486	485	490	485	486	. .	484	. .	489	. .	487	. .
. .	. .	. .	978	979	988	999	. .	967	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	988	990	. .	. .	. .	. .	985	984
. .	. .	. .	562	562	575	578	561	557	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	571	567	. .	. .	. .	. .	567	566
. .	. .	. .	318	. .	321	. .	307	. .	. .	. .	. .	. .	. .	. .	*316*	. .	. .	. .	. .	. .	321	. .	320	. .	327	. .	318	. .
. .	. .	. .	647	. .	650	. .	636	. .	. .	. .	. .	. .	. .	. .	*650*	. .	. .	. .	. .	. .	652	. .	653	. .	656	. .	651	. .
. .	. .	. .	024	023	030	029	013	015	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	029	029	. .	. .	. .	. .	024	024
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	973	973	. .	. .	. .	. .	973	973
. .	. .	. .	501	. .	509	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	505	. .
. .	. .	. .	444	. .	447	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	446	. .
215	. .	. .	223	. .	230	. .	212	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	237	. .	226	. .
652	638	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	652	638
. .	. .	. .	423	. .	436	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	430	. .
. .	. .	. .	583	589	584	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	584	589
388	. .	. .	392	. .	400	. .	386	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	406	. .	406	. .
. .	. .	. .	517	520	513	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	515	520
. .	. .	. .	051	057	053	. .	041	043	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	048	050
432	. .	. .	436	. .	442	. .	426	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	449	. .	441	. .
513	521	. .	522	520	. .	536	529	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	539	539	528	527
208	. .	. .	213	. .	217	. .	213	. .	. .	. .	221	. .	215	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	225	. .	224	. .
460	502	. .	476	482	. .	485	480	479	. .	447	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	472	479
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	521	523	548	523
766	. .	. .	768	. .	767	. .	758	. .	762	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	778	. .	773	. .
424	423	. .	424	422	428	426	425	419	. .	406	432	431	429	423	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	427	421
. .	. .	. .	596	. .	600	. .	590	. .	. .	. .	600	. .	595	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	601	. .	599	. .
662	669	. .	664	. .	668	672	668	678	. .	659	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	666	670
877	886	. .	872	. .	. .	. .	874	.	858	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	875	. .	875	886
669	. .	661	671	. .	667	. .	673	. .	658	. .	673	. .	667	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	665	. .	669	. .
345	. .	344	341	. .	343	. .	352	. .	338	. .	344	. .	344	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	343	. .	345	. .
789	. .	786	787	. .	789	. .	796	. .	. .	. .	. .	. .	. .	809	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	785	. .	792	. .
121	. .	118	120	. .	120	. .	129	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	121	. .	123	. .
. .	. .	066	. .	. .	. .	. .	076	068	. .	051	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	071	060
815	808	785	820	807	808	807	. .	822	. .	798	819	809	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	809	809
481	. .	. .	476	. .	478	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	474	. .	474	. .
027	. .	. .	026	034	023	. .	. .	. .	022	. .	026	. .	027	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	024	. .	021	034

	Intensity in Arc	Intensity in Sun	Nature in Arc	Kind of Standard		P	E	Pl 5 ⊙52 III ⊙39 IV	Pl 6 ⊙52 III ⊙39 IV	Pl 8 ⊙55 III ⊙41 IV	Pl 9 ⊙55 III ⊙41 IV	Pl 16 ⊙59 II ⊙39 III	Pl 17 ⊙59 II ⊙39 III	Pl 17 ⊙59 II ⊙39 III	Pl 18 ⊙59 II ⊙39 III
								R a ⊙	R a ⊙	R a ⊙	R a ⊙	R a ⊙	R a ⊙	R a ⊙	R a ⊙
– Fe	5	d 3,4	. .	⊙	3942*	. .	. .	545	547	550	. .	567	560	557	550
Al	20	10	R	M	3944	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ca	4	2	. .	M	3949†	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	4	4	. .	⊙″	3950	. .	. .	081	092	092	. .	108	112	111	104
Y	10	2	. .	⊙	3950	. .	. .	480	488	489	. .	504	504	502	505
Fe	2	2	. .	⊙′	3953 or 4	. .	. .	983	001	996	. .	002	008	000	992
Fe, Ca	5,6	6	. .	⊙′	3957	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	3	3	. .	⊙″	3960	. .	. .	408	452	416	. .	. .	. .	431	. .
Al	15	15	R	M	3961	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ca	70	200	R	M	3968	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
H	. .	. .	. .	. .	3970.05°	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	5	4	. .	⊙′	3971‡	. .	. .	457	463	468	. .	488	491	479	491
Ca	5	3	. .	M	3973	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	5	4	. .	⊙″	3977	. .	. .	. .	873	880	. .	891	897	898	890
Fe, Ti	6	4	. .	⊙	3981	. .	. .	. .	890	906	. .	. .	. .	921	. .
Cr, Fe	5,3	d 6	. .	⊙	3984§	. .	. .	. .	061	062	. .	. .	. .	091	. .
– Mn	4	d 7	. .	⊙	3986	. .	. .	. .	886	888	. .	. .	. .	. .	. .
– Mn, Co	4,2	t 7	. .	⊙	3987	. .	. .	. .	199	205	. .	. .	. .	. .	. .
Co, Fe, Ti	4,1,2	3	. .	⊙	4003	. .	. .	. .	892	912	. .	. .	. .	. .	. .
Fe +	. .	10	. .	⊙	4005‖	. .	. .	312	290	314	. .	. .	. .	. .	. .
Fe	. .	3	. .	⊙″	4016	. .	. .	. .	. .	575	. .	. .	. .	. .	. .
Fe, Zr	2,2	4	. .	⊙″	4029	. .	. .	. .	792	798	. .	. .	. .	. .	. .
Mn	50	6	R	M	4030¶	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Mn	40	5	R	M	4033**	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Mn	30	4	R	M	4034††	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Mn	5	2	. .	M	4035.9††	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
K	50	1	R	M	4044	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	20	15	R	M	4045	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
K	40	½?	R	M	4047	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Zr, Mn, Cr	1,8,2	t	. .	⊙	4048	. .	894	. .	880	890	. .	. .	. .	. .	. .
Mn	8	5	. .	⊙″	4055	. .	698	. .	693	705	. .	. .	. .	. .	. .
Fe	5	5	. .	⊙″	4062	. .	. .	. .	600	611	. .	. .	. .	. .	. .
Fe	20	12	R	M	4063	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	15	10	. .	⊙	4071	901	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	4	4	. .	⊙″	4073	884	909	. .	. .	931	937	. .	. .	. .	. .
Sr	100	8	R	⊙	4077	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .

* Component .085, apart.

† Red component of a triple.

‡ Components about .06 apart.

§ Red component of a double.

‖ Seven lines, mostly Fe.

¶ Violet component of double.

** Violet component of double.

†† Red component of double.

° Value determined by Dr. Ames.

Sub-standard	⊙ M 40 II															⊙ M 38 II		Mean	
	Ca J c ⊙	Ca J c M	Ca M b ⊙	Co J c ⊙	Co J c M	Zr J c ⊙	Zr J c M	Ba J c ⊙	Ba J c M	Sr J c ⊙	Sr J c M	Si D J a ⊙	Si D J a M	Si E J a ⊙	Si E J a M	Ni J a ⊙	Ni J a M	⊙	M
553	568	. .	566	567	. .	560	. .	. .	. .	559	. .	564	. .	565	. .	559	. .	559	. .
. .	157	163	145	159	167	155	154	172	180	. .	164	158	162	161	164	. .	. .	159	165
. .	047	070	020	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	034	070
098	100	. .	. .	098	. .	100	. .	113	. .	103	. .	102	. .	102	. .	101	. .	101	. .
495	496	. .	. .	496	. .	495	. .	508	. .	496	. .	. .	. .	. .	. .	496	. .	497	. .
998	001	. .	. .	002	. .	003	. .	018	. .	001	. .	. .	. .	. .	. .	003	. .	001	. .
. .	179	228	180	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	180	228*
. .	428	. .	430	427	. .	425	. .	441	. .	430	. .	. .	. .	. .	. .	428	. .	429	. .
. .	674	676	671	686	684	672	675	686	696	. .	674	677	679	675	677	469	. .	676	680
. .	626	621	612	622	615	610	610	. .	625	. .	603	631	625	. .	623	. .	. .	620	617
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
475	476	. .	478	. .	. .	. .	. .	484	. .	484	. .	. .	. .	. .	. .	. .	. .	478	. .
. .	831	881	839	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	835	881
885	890	. .	. .	891	. .	887	. .	904	. .	890	. .	897	. .	893	. .	. .	. .	891	. .
. .	918	. .	. .	916	. .	913	. .	930	. .	917	. .	. .	. .	. .	. .	919	. .	914	. .
. .	085	. .	. .	082	. .	075	. .	. .	. .	. .	. .	. .	. .	. .	. .	087	. .	078	. .
. .	. .	. .	927	909	. .	902	. .	. .	. .	. .	. .	. .	. .	. .	. .	905	. .	903	. .
. .	. .	. .	234	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	224	. .	216	. .
. .	920	. .	924	919	. .	912	. .	931	. .	921	. .	. .	. .	. .	. .	916	. .	916	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	305	. .
. .	576	. .	. .	574	. .	568	. .	592	. .	580	. .	. .	. .	. .	. .	. .	. .	578	. .
. .	798	. .	. .	796	. .	788	. .	807	. .	. .	. .	795	. .	794	. .	. .	. .	796	. .
. .	916	916	. .	912	. .	902	. .	924	924	. .	918	. .	. .	. .	. .	. .	. .	914	919
. .	227	225	. .	223	. .	215	. .	233	233	. .	232	. .	. .	. .	. .	. .	. .	225	230
. .	643	647	. .	641	. .	634	633	647	651	. .	637	. .	. .	. .	. .	. .	. .	641	642
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
. .	. .	. .	. .	295	305	291	297	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	293	301
. .	982	983	971	969	969	966	964	989	986	. .	979	970	972	975	974	. .	. .	975	975
. .	. .	. .	. .	. .	374	. .	372	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	373
. .	900	. .	893	894	. .	888	. .	905	. .	898	. .	887	. .	894	. .	. .	. .	893	. .
. .	705	. .	705	700	. .	694	. .	708	. .	705	. .	698	. .	700	. .	. .	. .	701	. .
. .	604	. .	604	598	. .	596	. .	. .	. .	603	. .	. .	. .	. .	. .	. .	. .	602	. .
. .	758	748	754	752	750	747	747	768	766	. .	759	758	762	754	752	. .	. .	756	755
. .	905	909	907	901	899	897	894	913	906	. .	900	905	908	901	903	. .	. .	904	903
. .	926	. .	933	915	. .	914	. .	930	. .	917	. .	923	. .	920	. .	. .	. .	920	. .
. .	882	881	895	876	867	876	860	888	888	883	882	. .	. .	. .	. .	. .	. .	883	876

* Ca line measured.

	Intensity in Arc	Intensity in Sun	Nature in Arc	Kind of Standard		St	St	P	E	Pl 6 ⊙52 III ⊙39 IV	Pl 8 ⊙55 III ⊙41 IV	Pl 9 ⊙55 III ⊙41 IV	Pl 10 ⊙57 III ⊙43 IV	Pl 12 ⊙42 III ⊙32 IV	Pl 13 ⊙42 III ⊙32 IV	⊙ M 44 II, M 29 III, M 22 IV					
						⊙	⊙	⊙	⊙	R a ⊙	R a ⊙	R a ⊙	R a ⊙	R a ⊙	R a ⊙	Ba J c ⊙	Ba J c M	Ca J c ⊙	Ca J c M	Sr J c ⊙	Sr J c M
Fe, Mn	2,5	3,2	. .	⊙	4083	. .	. .	792	. .	753	766	759	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	2	2	. .	⊙	4083	. .	. .	. .	. .	926	938	932	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	2	2	. .	⊙″	4088	. .	. .	. .	. .	714	716	716	. .	. .	. .	. .	. .	. .	. .	. .	. .
Si, Mn	3,1	4	. .	⊙″	4103	. .	. .	. .	. .	099	107	104	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	5	4 d ?	. .	⊙″	4107	. .	. .	629	646	635	653	654	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	3	4	. .	⊙″	4114	. .	. .	554	598	600	608	609	. .	. .	. .	. .	. .	. .	. .	. .	. .
Cr, Co	1,10	1,3	R	⊙	4121‡	. .	. .	. .	. .	471	491	487	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe, Cr	3,1	3	. .	⊙′	4121	. .	969	. .	. .	960	980	970	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	4	3	. .	⊙″	4157	. .	945	952	. .	948	. .	955	. .	941	942	. .	. .	. .	. .	. .	. .
C	. .	. .	. .	M	4158.2	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	4	3	. .	⊙″	4185	. .	067	028	053	. .	. .	079	. .	077	074	. .	. .	065	. .	. .	. .
C	. .	1	. .	⊙	4197*	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	244	248	265	. .
Zr, Fe	2,3	5	. .	⊙″	4199	. .	257	246	250	. .	. .	270	. .	271	246	265	. .	266	. .	268	. .
Fe	5	5	. .	⊙′	4202	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	201	. .	. .	. .	171	. .
Fe	2	2	. .	⊙	4215	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	616	. .	. .	. .
						665	666	669	667	. .	. .	666	. .	675	676	661	. .	. .	. .	659	. .
Sr	50	4	R	⊙ M	4215	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	692	688	687	. .	688
C	. .	1	. .	⊙	4216†	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	131	128	. .	. .
Fe	2	4	. .	⊙″	4222	381	381	405	388	. .	. .	390	. .	380	383	374	. .	380	. .	374	. .
Ca	50	10	R	⊙ M	4226	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	892	896	893	921	. .	889
Fe	4	5	. .	⊙′	4250	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	290	300	. .	. .
Fe	5	6	. .	⊙′	4250	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	963	957	. .	947
Cr	50	6	R	⊙″ M	4254	. .	500	510	517	. .	. .	. .	. .	. .	. .	495	. .	505	. .	506	499
Fe	6	7	R	⊙	4260	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	643	643	. .	658
−Fe	1	d 1,2	. .	⊙	4267	. .	. .	. .	934	. .	. .	. .	. .	963	982	. .	. .	959	. .	957	. .
Fe	10	7	R	⊙ M	4271	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	918	918	928	925	. .	920
Cr	40	5	R	⊙ M	4274	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ca	4	3	R	. .	4283	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	169	172	178	179
Ca	4	3	R	⊙	4289	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	520	525	526	526	528	529
Cr	30	4	R	⊙ M	4289	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	888
	. .	d 4	. .	⊙′	4293	. .	. .	246	263	. .	. .	. .	236	. .	272	238	. .	244	. .	252	. .
Ca	2	2	R	⊙	4299	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	149	157	149	146	159	161
Ca	6	4	R	. .	4302	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	686	690	695	693	693	694
Sr	8	2	. .	. .	4305	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	636
Ti	10	4	R	⊙ M	4306	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	076	079	. .	080

* First line of 2d head of a carbon band.

† First line of 1st head of a carbon band.

‡ Co line measured.

⊙ M 44 II, M 29 III, M 22 IV												⊙ M 40 II, M 27 III												Mean	
Fe J c ⊙	Fe J c M	Si I J c ⊙	Si I J c M	Si I J a ⊙	Si I J a M	Si I J a ⊙	Si I J a M	Si J J a ⊙	Si J J a M	Ca M b ⊙	Na M b ⊙	Ca J c ⊙	Ca J c M	Ca M b ⊙	Co J c ⊙	Co J c M	Zr J c ⊙	Zr J c M	Ba J c ⊙	Sr J c ⊙	Mg J a ⊙	Mg J b ⊙	Mg J b ⊙	⊙	M
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	763	. .	. .	. .	. .	. .	. .	. .	770	. .	. .	. .	767	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	920	. .	. .	. .	. .	. .	. .	. .	925	. .	. .	. .	928	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	719	. .	699	. .	. .	. .	. .	728	730	. .	. .	. .	716	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	099	. .	105	094	. .	096	. .	101	101	. .	. .	. .	101	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	650	. .	648	643	. .	646	. .	650	648	. .	. .	. .	646	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	607	. .	. .	600	. .	602	. .	606	600	. .	606	604	600	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	483	. .	483	474	476	. .	. .	474	477	. .	483	484	481	476
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	968	. .	974	956	. .	965	. .	964	966	. .	969	973	968	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	949	. .	960	946	. .	945	. .	935	950	951	946	951	948	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
062	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	064	. .	063	063	. .	066	. .	066	067	058	. .	056	063	. .
. .	258	. .	253	. .	. .	. .	. .	. .	. .	. .	. .	255	254	. .	. .	. .	. .	266	. .	240	. .	. .	249	251	256
259	260	250	253	. .	. .	. .	. .	. .	. .	276	268	266	. .	261	269	. .	264	. .	274	267	260	. .	. .	263	257
194	196	185	177	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	188	187
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	615	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	616	. .
668	. .	. .	. .	. .	. .	. .	. .	. .	. .	659	667	. .	. .	665	. .	. .	. .	. .	. .	. .	667	666	668	667	. .
. .	685	680	679	. .	. .	. .	. .	. .	. .	. .	. .	694	697	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	687	688
. .	123	. .	124	. .	. .	. .	. .	. .	. .	. .	. .	143	146	. .	. .	. .	. .	141	. .	. .	. .	. .	. .	137	133
374	396	360	. .	379	. .	379	. .	386	. .	387	378	386	. .	382	. .	. .	. .	. .	. .	. .	. .	. .	. .	381	396
889	892	874	873	903	902	899	901	893	900	888	876	910	903	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	892	898
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	290	300
965	951	941	941	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	956	949
505	. .	488	489	504	. .	506	. .	495	. .	498	492	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	502	494
643	657	627	631	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	638	647
. .	. .	. .	. .	959	. .	961	. .	954	. .	957	956	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	958	. .
929	919	914	914	931	931	932	914	921	920	923	916	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	924	920
964	. .	952	954	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	958	954
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	163	168	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	170	175
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	517	522	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	523	527
881	. .	881	880	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	881	884
. .	. .	. .	. .	253	. .	248	. .	249	. .	243	240	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	249	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	151	152	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	152	153
696	693	688	678	. .	. .	. .	. .	. .	. .	683	683	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	689	690
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	636
067	068	064	058	. .	. .	. .	. .	. .	. .	. .	078	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	071	071

	* Intensity in Arc	Intensity in Sun	Nature in Arc	Kind of Standard		St	St	U	P	E	Pl 11 ⊙59 III ⊙44 IV	Pl 10 ⊙57 III ⊙44 IV	Pl 15 ⊙44 III ⊙33 IV	Pl 1 ⊙45 III ⊙34 IV	Pl 13 ⊙42 III ⊙32 IV	Ca 46		⊙M 44 II, M 29 III, M 22 IV	
						⊙	⊙	⊙	⊙	⊙	R a ⊙	R a ⊙	R a ⊙	R a ⊙	R a ⊙	J c ⊙	J c M	Ba J c ⊙	Ba J c M
Ca	3	2	R	⊙	4307	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	905	903
						. .	. .	. .	126	019	. .	957	. .	. .	. .	. .	. .	. .	. .
Fe	4	5	R	⊙	4308	. .	. .	. .	. .	. .	. .	. .	. .	. .	058	. .	. .	074	071
Ca	4	3	R	⊙″	4318	. .	. .	. .	848	827	. .	809	. .	. .	844	. .	. .	810	812
Fe	10	7	R	⊙′ M	4325	. .	. .	. .	008	977	. .	918	. .	. .	995	. .	. .	932	931
Cr, Fe	2, 2	d 1,2	. .	⊙	4343	. .	. .	. .	367	357	388	378	. .	. .	. .	. .	. .	400	. .
Fe	4	3	. .	⊙″	4352	. .	900	. .	924	916	883	889	. .	. .	. .	. .	. .	905	. .
Ni, Cr, Zr	3,4,5	1,3,1	. .	⊙	4359	. .	. .	. .	760	776	. .	758	. .	. .	. .	. .	. .	792	. .
Fe	4	5	. .	⊙″	4369	. .	940	. .	942	936	941	944	. .	. .	. .	. .	. .	947	. .
Fe	5	5	. .	⊙″	4376	103	103	. .	085	100	097	097	. .	. .	. .	. .	. .	115	. .
Fe	10	10	R	. .	4383	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	727	724	731	726
Fe, Ti	2, 1	3, 1	. .	⊙	4391*	. .	. .	. .	147	145	144	. .	169	. .	. .	142	. .	153	. .
Fe	8	8	R	⊙ M	4404	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	924	920	939	931
V, ?	9, 3	2, 3	R	⊙	4407	. .	851	. .	847	850	858	. .	856	844	. .	846	. .	857	. .
Cd	. .	. .	. .	M	4413	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	6	6	R	⊙ M	4415	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	298	294	307	298
Ca	4	4	R	⊙″ M	4425	. .	610	. .	. .	. .	. .	. .	. .	. .	. .	606	606	612	612
Ca	5	4	R	⊙ M	4435	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	128	129	141	133
Ca	3	3	R	⊙″ M	4435	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	851	854	860	861
Fe	. .	5	. .	⊙″	4447	. .	. .	. .	900	906	901	. .	892	902	. .	894	. .	909	925
Ca	8	4	R	M	4454†	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	948	948	958	956
Ca	3	2	R	M	4456‡	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	042	059	053	050
Ca	1	1	. .	M	4456	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	790	786	. .	. .
Fe	. .	5	. .	⊙″	4494	729	736	721	732	724	. .	. .	729	731	. .	742	. .	742	. .
Cr, Zr	5, 2	4, 1	. .	⊙$_1$	4497	048	039	025	066	052	. .	. .	050	059	. .	030	. .	032	. .
Mn	. .	2	. .	⊙″	4499	. .	. .	. .	210	084	. .	. .	065	061	. .	069	. .	. .	. .
		1	. .	⊙′	4499	. .	. .	. .		330	. .	. .	315	313	. .	310	. .	. .	. .
Ti	6	5	. .	⊙′	4501	444	446	435	433	451	. .	. .	445	451	. .	447	. .	445	. .
C	. .	. .	. .	M	4502.6	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ti?	. .	4	. .	⊙″	4508	460	460	. .	446	451	. .	. .	454	469	. .	458	. .	453	. .
In	. .	. .	. .	M	4511	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
In	. .	. .	. .	M	4513	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ba	100	7	R	⊙″M	4554	. .	. .	. .	225	. .	. .	. .	. .	. .	. .	215	220	214	223
Ti	4	6	. .	⊙″	4563	. .	. .	. .	. .	. .	. .	. .	937	954	. .	942	. .	950	. .
Mg	3	5	. .	⊙″	4571	. .	. .	. .	273	282	. .	. .	287	279	. .	275	. .	287	. .
Ti	5	6	. .	⊙″	4572	. .	. .	. .	155	152	. .	. .	158	176	. .	153	. .	168	. .
Ca, Ti	3, 1	4	. .	⊙″	4578	. .	. .	. .	733	722	. .	. .	731	734	. .	733	. .	710	. .
Cr?	. .	4	. .	⊙″	4588	. .	. .	372	397	390	. .	. .	391	395	. .	379	. .	395	. .
Ti?	. .	4	. .	⊙″	4590	. .	. .	122	133	117	. .	. .	127	149	. .	127	. .	144	. .

* Components about .05 apart.

† Violet component of double. Other line Mn.

‡ Red component of double. Other line Mn.

⊙ M 44 II, M 29 III, M 22 IV														⊙ 44 II		Sub-standard	⊙48II	⊙ M 48 II, M 32 III, M 24 IV			Sub-standard	Sub-standard	M 48 I		Mean	
Ca J c ⊙	Ca J c M	Sr J c ⊙	Sr J c M	Fe J c ⊙	Fe J c M	Si I′ J c ⊙	Si I′ J c M	Si H J a ⊙	Si H J a M	Si I J a ⊙	Si I J a M	Si J J a ⊙	Si J J a M	Ca M b ⊙	Na M b ⊙		Ca 48 M b ⊙	Mg 48 J c ⊙	Mg 48 J c M	Sr J c ⊙	⊙	M	Sr J c ⊙		⊙	M
905	907	. .	907	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	902	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	904	906
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	034	. .
077	079	. .	081	065	069	063	057	077	075	080	078	070	068	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	071	072
816	818	815	818	811	. .	803	. .	817	. .	817	. .	811	. .	813	816	. .	. .	. .	. .	. .	. .	. .	. .	. .	818	816
933	929	. .	937	930	932	922	921	938	938	936	937	930	930	926	939	. .	. .	. .	. .	. .	. .	. .	. .	. .	940	932
395	. .	411	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	397	393	. .	. .	. .	. .	. .	. .	. .	. .	. .	387	. .
901	. .	906	. .	907	908	897	. .	901	. .	904	. .	900	. .	906	904	. .	. .	. .	. .	. .	. .	. .	. .	. .	903	908
781	. .	800	. .	779	. .	776	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	778	. .
942	. .	952	. .	944	948	934	. .	. .	. .	. .	. .	. .	. .	950	948	. .	. .	. .	. .	. .	. .	. .	. .	. .	943	948
106	. .	. .	. .	110	108	103	. .	104	. .	104	. .	103	. .	105	106	. .	. .	. .	. .	. .	. .	. .	. .	. .	103	108
718	714	734	726	725	727	716	716	717	718	721	719	716	714	712	709	. .	. .	. .	. .	. .	*721*	*720*	729	. .	721	721
143	. .	151	. .	155	. .	142	. .	. .	. .	. .	. .	. .	. .	148	149	. .	. .	. .	. .	. .	. .	. .	. .	. .	149	. .
926	928	934	927	941	941	919	923	929	928	930	930	925	927	926	904	. .	. .	. .	. .	. .	*927*	*928*	929	. .	927	928
851	. .	856	. .	861	. .	845	. .	848	. .	849	. .	848	. .	842	843	. .	. .	. .	. .	. .	. .	. .	. .	. .	850	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	181	. .	181
. .	. .	. .	303	297	299	297	294	301	299	298	299	296	290	. .	. .	. .	. .	. .	. .	. .	*299*	*297*	308	. .	299	298
615	620	611	616	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	604	603	. .	. .	. .	. .	. .	*609*	*614*	626	. .	609	616
138	143	132	133	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	119	. .	. .	. .	. .	. .	. .	*132*	*135*	126	. .	132	133
854	860	854	857	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	836	852	. .	. .	. .	. .	. .	*851*	*858*	847	. .	852	856
905	. .	900	. .	897	899	898	. .	898	. .	896	. .	893	. .	886	907	. .	. .	. .	. .	. .	. .	. .	. .	. .	899	912
955	958	937	938	945	. .	955	960	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	*950*	*952*	933	. .	950	949
045	072	. .	043	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	*047*	*056*	052	. .	047	055
795	795	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	793	791
742	. .	745	. .	737	756	740	. .	737	. .	738	. .	738	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	735	756
032	. .	. .	. .	034	. .	030	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	041	. .
. .	. .	070	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	070	. .
. .	. .	305	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	315	. .
449	. .	439	. .	439	. .	450	. .	444	. .	443	. .	445	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	444	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
465	. .	446	. .	457	. .	460	. .	452	. .	452	. .	453	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	456	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	474	. .	474
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	883	. .	883
206	222	200	204	216	. .	214	219	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	*213*	*218*	205	. .	213	212
936	. .	926	. .	945	. .	945	. .	936	. .	931	. .	928	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	939	. .
257	. .	260	. .	282	. .	278	. .	. .	. .	. .	. .	. .	. .	. .	. .	*276*	279	281	281	. .	*276*	. .	. .	. .	277	281
152	. .	139	. .	158	. .	155	. .	. .	. .	. .	. .	. .	. .	. .	. .	*157*	157	163	. .	. .	*157*	. .	. .	. .	157	. .
730	. .	722	. .	741	. .	735	. .	. .	. .	. .	. .	. .	. .	. .	. .	*730*	737	744	. .	. .	*730*	. .	807	. .	731	807
374	. .	366	. .	388	. .	381	. .	. .	. .	. .	. .	. .	. .	. .	. .	*386*	380	. .	. .	. .	*386*	. .	. .	. .	384	. .
122	. .	114	. .	137	. .	126	. .	. .	. .	. .	. .	. .	. .	. .	. .	*130*	127	. .	. .	127	*130*	. .	. .	. .	129	. .

	Intensity in Arc	Intensity in Sun	Nature in Arc	Kind of Standard		St	St	188	U	P	E	O	C	Pl 15 ⊙44 III ⊙33 IV	Pl 1 ⊙45 III ⊙34 IV	Pl 2 ⊙48 III ⊙36 IV	Pl 3 ⊙49 III ⊙37 IV	Pl 4 ⊙50 III ⊙38 IV	⊙ M 46	
						⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	R a ⊙	R a ⊙	R a ⊙	R a ⊙	R a ⊙	Ca J c ⊙	Ca J c M
Fe	2	4	. .	⊙″	4602	. .	. .	. .	. .	175	163	. .	. .	181	195	. .	. .	. .	184	. .
Li	100	. .	R	M	4602.25	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
C	. .	. .	. .	. .	4606.6	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Sr	50	2	R	⊙′ M	4607	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	514	521
?, Fe	4	d 2,6	. .	⊙$_1$	4611	. .	. .	. .	. .	450	438	. .	. .	. .	446	. .	. .	. .	459	. .
Ti, Co	4,5	2,3	. .	⊙′	4629	. .	. .	. .	. .	517	509	. .	. .	. .	. .	. .	. .	. .	524	. .
Fe	3	4	. .	⊙′	4637	. .	. .	. .	. .	. .	. .	. .	. .	683	684	688	. .	. .	686	. .
Fe	3	4	. .	⊙′	4638	. .	. .	. .	. .	. .	. .	. .	. .	182	223	207	. .	. .	195	. .
Fe	2	3	. .	⊙″	4643	. .	. .	. .	648	658	643	. .	. .	635	656	650	. .	. .	645	. .
Ni	6	3	R	. .	4648	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
?, Fe	3	d 7	. .	⊙′	4668	. .	. .	. .	. .	306	293	. .	. .	. .	. .	306	. .	. .	301	. .
Cd	. .	. .	. .	. .	4678	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	3	6	. .	⊙′	4679	. .	. .	. .	. .	022	020	. .	. .	. .	. .	026	. .	. .	036	. .
Zn	. .	2	. .	M	4680	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	2	2	. .	⊙″	4683	. .	745	. .	. .	728	745	. .	. .	. .	. .	748	. .	. .	747	. .
Ni	4	4	. .	⊙″	4686	. .	399	. .	. .	368	. .	. .	. .	. .	. .	397	. .	. .	401	. .
		4	. .	⊙′	4690	323	323	. .	322	345	325	. .	. .	. .	. .	322	. .	. .	323	. .
Ti, Fe	3,3	d 2,4	. .	⊙$_1$	4691*	575	575	. .	577	627	582	. .	. .	. .	. .	576	. .	. .	. .	. .
Mg	5	9	. .	⊙″	4703†	. .	180	. .	186	190	175	. .	. .	. .	. .	178	. .	. .	. .	. .
Ni	3	3	. .	⊙″	4703	. .	992	. .	965	973	985	. .	. .	. .	. .	991	. .	. .	. .	. .
Ni	9	6	R	M	4714	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Zn	. .	4	. .	⊙″ M	4722	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe, Mn	2,7	d 3,3	. .	⊙	4727	. .	. .	. .	. .	639	628	. .	. .	. .	. .	623	. .	. .	. .	. .
Mn	15	6	R	⊙″	4754	. .	. .	. .	. .	230	222	. .	. .	. .	. .	223	. .	. .	. .	. .
Mn	10	6	R	⊙″ M	4783	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Cd	. .	. .	. .	. .	4800	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
?, Ti	1	d 1,4	. .	⊙$_1$	4805	. .	. .	. .	. .	244	260	. .	. .	. .	. .	256	. .	. .	. .	. .
Zn	. .	3	. .	⊙″ M	4810	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Mn	10	6	R	⊙″ M	4823	. .	. .	695	. .	679	693	. .	. .	. .	. .	698	697	. .	. .	. .
Fe?	. .	4	. .	⊙″	4824	. .	. .	337	. .	294	319	. .	. .	. .	. .	327	325	. .	. .	. .
Fe	4	6	. .	⊙″	4859	. .	. .	. .	. .	925	. .	939	926	. .	. .	942	931	. .	. .	. .
H	. .	15	. .	⊙′	4861	. .	. .	. .	. .	503	. .	491	486	. .	. .	506	495	. .	. .	. .
Fe	7	7	. .	⊙″	4890	. .	945	. .	. .	936	. .	949	. .	. .	. .	932	943	. .	. .	. .
Ti	4	2	. .	⊙′	4900‡	. .	. .	. .	. .	098	. .	104	. .	. .	. .	. .	085	. .	. .	. .
Y	. .	2	. .	⊙′	4900‡	. .	. .	. .	. .	304	. .	302	. .	. .	. .	. .	302	. .	. .	. .
Cr, Fe	2,5	d ?6	. .	⊙″	4903	484	488	488	. .	491	. .	485	484	. .	. .	. .	492	. .	. .	. .
Pb	. .	. .	. .	M	4905	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	6	7	. .	⊙″ M	4919	. .	. .	. .	. .	. .	. .	. .	176	. .	. .	. .	189	192	. .	. .
Fe	9	t ?9	. .	⊙″ M	4920	. .	. .	. .	. .	674	. .	. .	674	. .	. .	. .	700	679	. .	. .

* Besides the double line measured there is another faint line on the red side.

† The Mg line is of the nature of a band shaded toward the red. It coincides with the solar line when there is very little material in the arc.

‡ The Ba line comes between these and does not coincide with either.

⊙ M 44 II, M 29 III, M 22 IV					Sub-Standard	⊙ 48		⊙ M 48 II, M 32 III, M 24 IV								Sub-standard	⊙ M 48 II, M 32 III, M 24 IV			Sub-Standard	Sub-Standard	48 M I		Mean	
Ba J c ⊙	Ca J c ⊙	Ca J c M	Sr J c ⊙	Fe J c ⊙		Sn J c ⊙	Ca J c ⊙	Mg J c ⊙	Mg J c M	Ba J c ⊙	Ba J c M	Sr J c ⊙	Sr J c M	Si J b ⊙	Si J b M	⊙	Si J c ⊙	Ni J c ⊙	Ni J c M	⊙	M	Sr J c		⊙	M
211	175	. .	174	199	*185*	174	183	180	. .	189	. .	184	. .	179	. .	*185*	184	175	. .	. .	. .	. .	. .	183	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
. .	496	501	. .	. .	. .	. .	511	. .	. .	. .	508	514	484	. .	. .	. .	. .	. .	. .	*511*	*504*	517	. .	509	506
. .	. .	. .	. .	463	. .	. .	456	. .	. .	462	. .	448	. .	. .	. .	. .	. .	456	. .	. .	. .	. .	. .	453	. .
. .	. .	. .	. .	. .	. .	512	517	515	. .	518	. .	514	. .	521	. .	. .	509	512	. .	. .	. .	. .	. .	515	. .
. .	. .	. .	. .	. .	. .	681	683	675	. .	680	. .	690	. .	678	. .	. .	687	682	. .	. .	. .	. .	. .	683	. .
. .	. .	. .	. .	. .	. .	185	189	175	. .	188	. .	206	. .	194	. .	. .	194	192	. .	. .	. .	. .	. .	194	. .
. .	. .	. .	. .	. .	. .	641	639	632	. .	639	. .	650	. .	643	. .	*644*	645	645	. .	. .	. .	. .	. .	645	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	835	833	. .	. .	. .	. .	835	833
. .	. .	. .	. .	. .	. .	297	300	. .	. .	. .	. .	315	. .	298	. .	. .	. .	307	. .	. .	. .	. .	. .	303	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	339	. .	339
. .	. .	. .	. .	. .	. .	029	029	. .	. .	024	. .	040	. .	023	. .	. .	. .	029	. .	. .	. .	. .	. .	028	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	319	. .	. .	. .	. .	. .	. .	. .	. .	. .	319
. .	. .	. .	. .	. .	. .	744	743	. .	. .	. .	. .	747	. .	742	. .	*744*	. .	742	. .	. .	. .	. .	. .	743	. .
. .	. .	. .	. .	. .	. .	401	. .	. .	. .	. .	. .	401	. .	399	. .	*398*	. .	396	. .	. .	. .	. .	. .	395	. .
. .	. .	. .	. .	. .	. .	323	320	. .	. .	320	. .	324	. .	. .	. .	*322*	. .	323	. .	. .	. .	. .	. .	324	. .
. .	. .	. .	. .	. .	. .	. .	574	. .	. .	. .	. .	569	. .	. .	. .	*574*	. .	578	. .	. .	. .	. .	. .	581	. .
. .	. .	. .	. .	. .	. .	. .	182	173	249	180	. .	. .	. .	. .	. .	*180*	. .	178	. .	. .	. .	. .	. .	180	249
. .	. .	. .	. .	. .	. .	996	994	987	. .	987	. .	988	. .	. .	. .	*992*	. .	991	. .	. .	. .	. .	. .	986	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	599	598	. .	. .	. .	. .	599	598
. .	. .	. .	. .	. .	. .	345	. .	. .	326	. .	. .	. .	. .	353	352	. .	. .	. .	. .	. .	. .	. .	. .	349	339
. .	. .	. .	. .	. .	. .	624	637	. .	. .	624	. .	627	. .	630	. .	. .	. .	617	. .	. .	. .	. .	. .	628	. .
. .	. .	. .	. .	. .	. .	234	. .	213	. .	237	. .	228	. .	231	. .	. .	. .	216	. .	. .	. .	. .	. .	226	. .
. .	. .	. .	. .	. .	. .	. .	. .	601	607	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	601	607
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	097	. .	097
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	253	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	723	725	. .	. .	. .	. .	. .	. .	. .	. .	723	725
. .	. .	. .	. .	. .	. .	702	. .	693	715	. .	. .	701	. .	706	. .	. .	. .	705	. .	. .	. .	. .	. .	697	715
. .	. .	. .	. .	. .	. .	329	. .	. .	. .	. .	. .	326	. .	332	. .	. .	. .	336	. .	. .	. .	. .	. .	325	. .
. .	. .	. .	. .	. .	. .	934	. .	942	. .	936	. .	936	. .	937	. .	*935*	923	937	. .	. .	. .	. .	. .	934	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	496	. .
. .	. .	. .	. .	. .	. .	949	. .	. .	. .	952	. .	. .	. .	950	. .	*947*	. .	948	. .	. .	. .	. .	. .	945	. .
. .	. .	. .	. .	. .	. .	099	. .	. .	. .	098	. .	106	. .	102	. .	*098*	095	099	. .	. .	. .	. .	. .	098	. .
. .	. .	. .	. .	. .	. .	308	. .	. .	. .	304	. .	305	. .	308	. .	*305*	317	306	. .	. .	. .	. .	. .	306	. .
. .	. .	. .	. .	. .	. .	489	. .	. .	. .	487	. .	487	. .	. .	. .	*488*	490	486	. .	. .	. .	. .	. .	488	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	634	. .	634
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	174	. .	. .	. .	. .	. .	183	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	685	. .	. .	. .	676	. .	682	676

	Intensity in Arc	Intensity in Sun	Nature in Arc	Kind of Standard		St	St	188	196	p	q	o	c	C	R¹
						⊙	⊙			⊙	⊙	⊙	⊙	⊙	⊙
Fe	2	4	. .	⊙″	4924	110	107	. .	. .	109	. .	109	112	. .	. .
Fe	3	2	. .	⊙″	4924	956	955	. .	. .	954	. .	953	. .	. .	. .
Ba	100	8	R	⊙ M	4934*	. .	. .	. .	. .	243	. .	234	248	. .	. .
Ti, Fe	1,3	3	. .	⊙′	4973	. .	. .	284	. .	239	. .	249	. .	. .	. .
?, Fe	3	4	. .	⊙″	4978	. .	. .	770	. .	811	. .	765	772	. .	. .
Ni, ?	5	4,1	. .		4980	. .	. .	. .	. .	350	. .	363	. .	. .	. .
Ti	10	4	R	⊙″ M	4981	. .	. .	. .	. .	885	. .	918	. .	. .	. .
Fe	3	4	. .	⊙″	4994	. .	. .	. .	. .	317	. .	317	. .	. .	. .
Ti, La	10,10	4	R, d	⊙″	4999†	. .	. .	. .	. .	694	702	. .	. .	. .	. .
Pb	. . .	. .	. .	M	5005	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	3	4	. .	⊙′	5005	. .	. .	. .	. .	905	. .	899	. .	. .	. .
Fe	. . .	. .	. .	⊙″	5006	. .	. .	. .	. .	310	. .	295	. .	. .	. .
Ti, Fe	10,3	6	R	⊙″	5007	. .	. .	. .	. .	436	422	432	. .	. .	. .
Mg band	. . .	. .	. .	. .	5007‡	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ti, Ti	10,5	d 2,1	R	⊙′	5014	. .	. .	. .	. .	420	400	208	. .	. .	. .
Ti	7	3	. .	⊙′	5020	. .	. .	. .	. .	211	197	. .	. .	. .	. .
Ti, Ni	6,3	d 5	. .	⊙′	5036	. .	. .	. .	. .	114	081	. .	. .	. .	. .
Ca	3	2	. .	M	5041	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	5	5	. .	⊙″	5050	. .	005	. .	000	009	024	008	. .	. .	. .
Fe	2	2	. .	⊙′	5060	250	252	. .	258	255	250	250	254	. .	. .
Ti	10	3	. .	⊙′	5064	834	832	. .	. .	822	. .	840	. .	. .	. .
Fe	4	4	. .	⊙″	5068	946	947	. .	945	940	943	939	. .	. .	. .
Fe	4	3	. .	⊙″	5083	. .	525	. .	. .	518	531	. .	. .	530	. .
Cd	. . .	. .	. .	M	5087	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	3	2	. .	⊙″	5090	. .	959	. .	. .	957	961	. .	. .	971	. .
Fe	3	2	. .	⊙′	5097§	. .	. .	. .	. .	157	. .	. .	. .	178	. .
Fe, (Cu)	3	3	. .	⊙″	5105	. .	718	. .	. .	740	716	721	. .	700	. .
Fe	3	3	. .	⊙″	5109	. .	. .	. .	823	821	. .	832	. .	806	. .
?, Fe	. . .	d 2,3	. .	⊙′	5110	. .	. .	. .	575	570	523	579	. .	556	. .
Ni	5	3	. .	⊙″	5115	. .	. .	. .	. .	550	556	. .	. .	542	. .
Ni, Fe	2,3	d 1,3	. .	⊙′	5121	. .	. .	. .	. .	797	785	. .	. .	785	. .
Co	3	3	. .	⊙″	5126	. .	. .	. .	. .	383	367	. .	. .	344	. .
Fe	4	4	. .	⊙″	5127	. .	. .	. .	. .	521	520	. .	. .	520	. .
Fe, ?	1	d 6	. .	⊙″	5133	. .	. .	. .	875	872	870	874	873	860	. .
Fe	4	6	. .		5139	. .	. .	. .	. .	. .	. .	. .	. .	. .	444
						. .	. .	. .	. .	532	. .	. .	. .	530	. .
Fe	5	6	. .		5139	. .	. .	. .	. .	. .	. .	. .	. .	. .	646
Fe	2	3	. .	⊙″	5141	. .	. .	. .	. .	901	. .	. .	. .	906	937
Ni	5	3	. .	⊙′	5142	. .	. .	. .	. .	. .	. .	. .	. .	. .	967
						. .	. .	. .	. .	045	041	. .	. .	056	. .
Fe, Al band	3	4	. .	⊙′	5143	. .	. .	. .	. .	. .	. .	. .	. .	. .	103

* The solar line has a component very near on the violet side.

† Ti line measured.

‡ Commencement of head.

§ Component to violet belonging to Ni ?

Pl 3 ⊙49 III ⊙37 IV	Pl 4 ⊙50 III ⊙38 IV	Pl 5 ⊙52 III ⊙39 IV	Pl 6 ⊙52 III ⊙39 IV	⊙48	⊙ M 48 II, M 32 III, M 24 IV				Sub-stand-ard	Ni J c	M 52			Sub-Stand-ard	M 48 I		Mean	
R a ⊙	R a ⊙	R a ⊙	R a ⊙	Sn J c ⊙	Mg J c ⊙	Ba J c ⊙	Sr J c ⊙	Si J b ⊙	⊙	⊙	La J c ⊙	Ca J c ⊙	Ca J c M	⊙	Sr J c M		⊙	M
101	104	..	..	109	..	112	..	120	*107*	111	..	..	..	..	..	..	109	..
958	957	..	..	952	..	956	955	..	*955*	952	..	..	..	..	..	..	955	..
256	247	..	..	..	248	256	..	..	..	242	..	..	..	..	237	..	247	237
295	266	..	..	283	285	289	..	..	..	..	..	..	..	..	..	..	274	..
785	786	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	782	..
379	357	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	362	..
931	900	..	..	919	923	928	..	..	..	..	..	..	..	*915*	893	..	915	893
326	303	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	316	..
..	674	..	..	689	699	..	..	..	..	..	..	701	..	*695*	668	..	693	668
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	634	..	634
898	893	..	..	899	913	..	..	..	..	..	909	912	..	..	..	..	904	..
299	296	..	..	..	..	..	..	..	..	..	322	313	..	..	..	..	303	..
436	419	..	..	..	..	..	..	..	..	..	437	434	..	..	..	..	431	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	478	..	473
430	420	..	..	..	..	..	..	..	..	..	441	432	..	..	412	..	422	412
216	199	..	..	..	..	..	..	..	..	..	224	213	..	..	..	..	210	..
122	111	..	..	..	..	..	..	..	..	..	130	121	..	..	..	..	113	..
..	..	..	..	..	..	..	..	..	..	..	..	795	839	..	894	..	795	867
010	005	003	..	..	..	..	..	..	..	..	008	005	..	..	..	..	008	..
253	244	255	..	..	..	..	..	..	..	..	252	249	..	..	..	..	252	..
838	831	832	..	..	..	..	..	..	..	..	832	836	..	..	..	..	833	..
950	949	949	..	..	..	..	..	..	..	..	947	947	..	..	..	..	946	..
..	530	518	..	..	..	..	..	..	..	..	..	522	..	..	..	..	525	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	001	..	001
..	958	958	..	..	..	..	..	..	..	..	..	952	..	..	..	..	959	..
..	192	177	170	..	..	..	..	..	..	..	..	179	..	..	..	..	176	..
..	730	713	722	..	..	..	..	..	..	..	710	715	..	..	..	..	719	..
..	836	827	829	..	..	..	..	..	..	..	820	831	..	..	..	..	825	..
..	589	583	574	..	..	..	..	..	..	..	572	579	..	..	..	..	570	..
..	579	542	570	..	..	..	..	..	..	..	..	568	..	..	..	..	558	..
..	808	803	792	..	..	..	..	..	..	..	..	812	..	..	..	..	797	..
..	380	368	369	..	..	..	..	..	..	..	..	373	..	..	..	..	369	..
..	534	543	531	..	..	..	..	..	..	..	..	539	..	..	..	..	530	..
..	869	874	872	..	..	..	..	..	..	..	..	871	..	..	..	..	871	..
..	..	441	..	..	..	..	..	..	..	..	..	426	..	..	..	..	437	..
..	..	..	554	..	..	..	..	..	..	..	..	..	..	..	..	..	539	..
..	..	648	..	..	..	..	..	..	..	..	..	642	..	..	..	..	645	..
..	..	925	910	..	..	..	..	..	..	..	..	..	..	..	..	..	916	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	967	..
..	..	038	029	..	..	..	..	..	..	..	..	..	..	..	..	..	042	..
..	..	..	..	..	..	..	..	..	..	..	..	109	..	..	..	..	106	..

	Intensity in Arc	Intensity in Sun	Nature in Arc	Kind of Standard		St	196	p	q	O	c	C	R	R¹	Pl 5 ☉52 III ☉39 IV	Pl 6 ☉52 III ☉39 IV	Pl 8 ☉55 III ☉41 IV	☉ M 52 II			Sub-standard	M 48 I	M 56 I	Mean	
								☉	☉	☉	☉	☉	☉	☉	R a ☉	R a ☉	R a ☉	La J c ☉	Ca J c ☉	Ca J c M	☉	Sr J c	Sr J c	☉	M
Ni, ?	5, ?	3	. .	☉″	5146	. .	. .	657	680	. .	. .	650	. .	670	661	670	. .	. .	659	. .	. .	. .	. .	664	. .
Fe, Mn	4, 2	d 3,1	. .	☉	5151*	. .	. .	016	016	. .	. .	020	. .	034	043	027	. .	. .	024	. .	. .	. .	. .	026	. .
Ti, ? Co, ?	. .	2	. .	☉″	5154	. .	. .	222	210	. .	. .	240	. .	253	244	246	. .	. .	247	. .	. .	. .	. .	237	. .
Ni	6	2	. .	☉″	5155	. .	. .	931	916	. .	. .	932	. .	949	942	948	. .	. .	941	. .	. .	. .	. .	937	. .
Fe, ?	. .	2	. .	☉″	5159	. .	282	247	210	. .	. .	248	. .	233	236	243	. .	221	236	. .	. .	. .	. .	240	. .
Fe	4	4	. .	☉″	5162	. .	. .	448	430	450	451	456	454	441	454	454	. .	438	452	. .	*447*	. .	. .	448	. .
C ‡	. .	1	. .	M	5165	. .	. .	. .	. .	. .	. .	190	. .	. .	. .	. .	. .	. .	. .	. .	. .	217	265	190	241
Fe	2	2	. .	☉″	5165	. .	. .	558	595	. .	. .	600	619	595	574	578	. .	. .	586	. .	. .	. .	. .	588	. .
Mg	20	8	R	M	5167	. .	. .	. .	. .	. .	. .	. .	. .	498	. .	. .	. .	. .	503	. .	. .	497	479	501	488
						. .	. .	572	. .	. .	. .	565	558	. .	586	581	. .	. .	. .	. .	. .	. .	. .	572	. .
Fe	6	6	. .	M	5167	. .	. .	. .	. .	. .	. .	. .	. .	696	. .	. .	. .	. .	676	. .	. .	671	657	686	664
Fe	3	4	. .	☉″	5169 †	. .	. .	. .	. .	. .	. .	. .	. .	067	. .	. .	. .	. .	074	. .	. .	. .	. .	066	. .
						. .	. .	158	. .	. .	. .	154	181	. .	159	152	. .	. .	. .	. .	. .	. .	. .	161	. .
Fe	3	4	. .	☉″	5169	. .	. .	. .	. .	. .	. .	. .	. .	220	. .	. .	. .	. .	216	. .	. .	. .	. .	218	. .
Fe	5	5	. .	☉″	5171	. .	. .	772	. .	784	776	774	807	782	793	780	. .	. .	777	. .	. .	. .	. .	783	. .
Mg	35	10	R	☉″M	5172	. .	. .	874	. .	. .	. .	873	874	862	870	878	. .	. .	869	. .	*871*	858	873	871	866
Ti	10	. .	R	☉″	5173	. .	. .	896	. .	917	901	891	931	922	921	910	. .	. .	917	. .	. .	. .	. .	912	. .
Mg	40	20	R	☉″M	5183	. .	. .	789	805	. .	800	789	808	793	787	768	. .	. .	788	. .	*792*	792	789	792	791
Ti	2	4	. .	☉″	5188	. .	. .	. .	. .	. .		. .	. .	863	. .	. .	. .	. .	862	. .	. .	. .	. .	863	. .
						. .	. .	951	950	. .	. .	949	956	. .	955	926	. .	. .	. .	. .	. .	. .	. .	948	. .
Ca	6	4	. .	☉″	5189	. .	. .	. .	. .	. .	. .	. .	. .	019	. .	. .	. .	. .	020	019	. .	. .	. .	020	019
Ti	10	3	. .	☉″M	5193	. .	. .	129	128	. .	. .	120	139	142	148	159	. .	. .	144	. .	*139*	144	123	139	134
Fe	3	4	. .	☉″	5198	. .	. .	884	872	. .	. .	883	906	870	886	896	. .	. .	885	. .	. .	. .	. .	885	. .
?, Fe	?, 4	d 2,3	. .	☉″	5202	. .	. .	483	483	480	. .	469	497	459	511	476	. .	. .	488	. .	. .	. .	. .	483	. .
Cr, Fe	8, 3	4, 3	R	☉″	5204	. .	. .	708	. .	711	. .	693	717	683	727	715	. .	. .	712	. .	. .	. .	. .	708	. .
Ti	10	3	R	☉″	5210	. .	. .	557	547	559	563	546	566	532	569	565	. .	. .	560	. .	*556*	545	552	556	549
Fe	3	4	. .	☉″	5215	. .	. .	352	330	. .	. .	355	361	335	361	365	. .	. .	356	. .	. .	. .	. .	352	. .
Fe	3	4	. .	☉″	5217	. .	. .	558	548	. .	. .	552	557	545	574	571	. .	. .	565	. .	. .	. .	. .	559	. .
Fe	2	3	. .	☉″	5225	. .	. .	689	672	. .	. .	684	700	667	704	706	. .	. .	701	. .	. .	. .	. .	690	. .
Fe	4	4	. .	☉″	5230	. .	. .	018	001	. .	. .	027	018	993	. .	. .	. .	. .	024	. .	. .	. .	. .	014	. .
Fe	7	7	. .	☉″	5233	. .	. .	134	126	. .	. .	132	128	. .	125	124	. .	. .	128	. .	. .	. .	. .	124	. .
Fe	3	3	. .	☉″	5242	. .	. .	652	663	. .	. .	653	673	655	655	675	660	. .	671	. .	. .	. .	. .	662	. .
Fe	2	2	. .	☉″	5250	. .	411	. .	. .	. .	. .	392	413	391	368	392	377	382	395	. .	. .	. .	. .	391	. .
Fe	3	3	. .	☉″	5250	. .	834	. .	. .	. .	. .	815	837	830	825	824	821	818	825	. .	. .	. .	. .	825	. .
Fe	2	3	. .	☉″	5253	. .	. .	613	620	. .	. .	652	652	643	631	644	649	635	646	. .	. .	. .	. .	649	. .
Ca	2	1	. .	☉ M	5260	. .	. .	. .	. .	. .	. .	562	563	550	. .	. .	. .	. .	553	556	. .	. .	. .	557	556
Ca, Cr	6, 2	3	. .	☉	5261	. .	. .	865	883	. .	. .	883	898	891	886	880	871	876	874	871	. .	. .	. .	880	. .
		1	. .	☉	6262	. .	. .	. .	. .	. .	. .	. .	. .	341	. .	. .	. .	. .	. .	. .	. .	. .	. .	341	. .
Ca	6	2	. .	☉ M	5262	. .	. .	. .	. .	. .	. .	381	375	406	. .	. .	. .	. .	403	406	. .	. .	410	391	408
Cr	4	3	R	☉″	5264	. .	. .	. .	. .	. .	. .	. .	. .	320	. .	. .	. .	. .	333	. .	. .	. .	. .	327	. .
						367	. .	. .	. .	. .	. .	368	378	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	371	. .
Ca	6	3	. .	☉″	5264	. .	. .	. .	. .	. .	. .	. .	. .	394	. .	. .	. .	. .	396	400	. .	. .	415	395	408

---

* Components about .05 apart.

† Components about .138 apart as measured by Rowland.

‡ Heavy line very near the commencement of the carbon band. Much of the band can be seen on my map of the solar spectrum extending to the left.

	Intensity in Arc	Intensity in Sun	Nature in Arc	Kind of Standard		St	St	196 ⊙64 IV ⊙50 V ⊙42 VI	p	q	c	C	R	R¹	Pl 5 ⊙52 III ⊙39 IV	Pl 6 ⊙52 III ⊙39 IV	Pl 8 ⊙55 III ⊙41 IV	Pl 9 ⊙55 III ⊙41 IV	⊙ M 52 II			56 II ⊙ M	Sub-standard	Sub-standard	M 56 I	M	Mean	
						⊙	⊙		⊙	⊙	⊙	⊙	⊙	⊙	R a ⊙	R a ⊙	R a ⊙	R a ⊙	La J c ⊙	Ca J c ⊙	Ca J c M	Ca* J c ⊙	⊙	M	Sr J c		⊙	M
Ni, Ca	4,8	3	. .		¶5265	. .	. .	. .	. .	. .	. .	. .	. .	730	. .	. .	. .	. .	. .	724	725	. .	. .	. .	. .	. .	727	725
				⊙ .		. .	. .	. .	. .	. .	. .	797	781	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	789	. .
Cr	4	2	R		5265	. .	. .	. .	. .	. .	. .	. .	. .	884	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	884	. .
Fe	6	6	. .	⊙″	5266	. .	730	. .	. .	. .	. .	736	720	728	731	. .	. .	. .	. .	731	. .	. .	. .	. .	733	. .	729	733
Fe	8	8	. .	⊙″	5269	717	722	734	733	726	715	730	717	719	721	711	718	. .	721	719	. .	. .	*722*	. .	714	. .	722	714
Ca	10	4	R	⊙″ M	†5270	. .	. .	. .	. .	. .	. .	. .	. .	457	. .	. .	. .	. .	. .	438	436	. .	*448*	*436*	454	. .	448	445
						497	492	502	490	. .	497	486	490	. .	493	503	495	. .	. .	. .	. .	. .	. .	. .	. .	. .	495	. .
Fe	6	4	. .	⊙″ M	5270	. .	. .	. .	. .	. .	. .	. .	. .	529	. .	. .	. .	. .	. .	537	. .	. .	. .	. .	. .	. .	533	. .
Fe	3	3	. .	⊙″	5273	. .	346	. .	. .	. .	. .	. .	360	351	330	338	. .	. .	. .	340	. .	. .	. .	. .	. .	. .	344	. .
						. .	. .	. .	437	440	. .	440	. .	. .	. .	. .	453	. .	. .	. .	. .	. .	. .	. .	. .	. .	443	. .
Fe	3	3	. .	⊙″	5273	. .	550	. .	. .	. .	. .	. .	544	545	561	569	. .	. .	. .	557	. .	. .	. .	. .	. .	. .	554	. .
?	?	2																										
Cr	5	t 2	. .	⊙″	5276	. .	. .	. .	191	204	. .	195	200	204	206	221	218	. .	. .	203	. .	. .	. .	. .	. .	. .	205	. .
Co	3	½																										
Fe	4	5	. .	⊙″	5281	. .	. .	. .	959	971	. .	962	006	965	955	961	967	. .	. .	965	. .	. .	. .	. .	. .	. .	968	. .
Fe	5	6	. .	⊙″	5283	. .	. .	. .	795	814	. .	810	816	799	794	790	801	. .	. .	809	. .	. .	. .	. .	. .	. .	803	. .
Fe	2	2	. .	⊙″	5288	. .	. .	708	689	721	. .	709	750	703	698	702	703	. .	. .	798	. .	. .	. .	. .	. .	. .	708	. .
Cr	70	3	R	⊙″	5296	. .	. .	. .	863	868	858	884	892	888	. .	866	864	. .	. .	870	. .	. .	. .	. .	. .	. .	873	. .
Cr	2	2	. .	⊙″	5300	. .	. .	. .	905	. .	919	914	942	. .	. .	910	911	. .	. .	926	. .	. .	. .	. .	. .	. .	918	. .
Fe	3	3	. .	⊙″	5307	. .	. .	. .	538	566	527	555	574	. .	. .	530	540	. .	. .	538	. .	. .	. .	. .	. .	. .	546	. .
Fe, ?	. .	4	. .	⊙	‡5316	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	790	. .	. .	. .	. .	. .	. .	790	. .
						. .	. .	. .	866	876	. .	858	878	. .	. .	858	881	. .	. .	. .	. .	. .	. .	. .	. .	. .	870	. .
Co, ?	2	3	. .	⊙	5316	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	950	. .	. .	. .	. .	. .	. .	950	. .
Fe	9	8	. .	⊙″	5324	. .	. .	. .	382	. .	. .	383	384	. .	. .	347	371	. .	. .	369	. .	. .	. .	. .	. .	. .	373	. .
Fe, ?	3	4	. .	⊙′	5333	. .	. .	. .	112	100	. .	089	115	. .	. .	069	090	. .	. .	066	. .	. .	. .	. .	. .	. .	092	. .
Ca	7	5	. .	⊙′ M	5349	. .	. .	. .	. .	. .	. .	639	623	. .	. .	. .	. .	. .	. .	601	599	. .	. .	. .	. .	. .	623	599
Th	. .	. .	. .	M	5350	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	650	. .	650
Fe, Ni	3, 3	4	. .	$\odot_1$	§5353	. .	. .	. .	593	600	. .	578	608	. .	. .	. .	602	. .	. .	569	. .	. .	. .	. .	. .	. .	592	. .
		2	. .	⊙	5361	. .	. .	. .	820	. .	. .	804	824	. .	. .	. .	799	. .	. .	820	. .	. .	. .	. .	. .	. .	813	. .
Fe, Co,	. .	1	. .	$\odot_1$	‖5363	. .	. .	. .	024	. .	. .	008	003	. .	. .	. .	007	. .	. .	. .	. .	. .	. .	. .	. .	. .	011	. .
?	. .	3	. .			. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	056	. .	. .	. .	. .	. .	. .	056	. .
Fe	4	6	. .	⊙″	5367	. .	. .	. .	667	681	. .	662	675	. .	. .	. .	668	. .	. .	669	. .	. .	. .	. .	. .	. .	670	. .
Fe	4	6	. .	⊙″	5370	. .	. .	. .	163	170	. .	152	168	. .	. .	. .	166	. .	. .	168	. .	. .	. .	. .	. .	. .	165	. .
Ni, Fe, Cr	2, 9. 2	d 2 7	. .	$\odot_1$	5371	. .	. .	. .	699	692	. .	665	684	. .	. .	. .	678	. .	. .	697	. .	. .	. .	. .	. .	. .	686	. .
Fe	2	3	. .	⊙″	5379	. .	. .	. .	775	784	. .	765	786	. .	. .	. .	772	. .	. .	777	. .	776	. .	. .	. .	. .	776	. .
Fe	6	6	. .	⊙″	5383	. .	. .	. .	585	576	560	571	584	. .	. .	. .	577	. .	577	576	. .	579	. .	. .	. .	. .	576	. .
Fe	3	4	. .	⊙″	5389	. .	681	. .	686	690	. .	675	682	. .	. .	. .	681	. .	683	683	. .	683	. .	. .	. .	. .	683	. .
Fe	4	5	. .	⊙″	5393	. .	377	. .	381	369	. .	382	377	. .	. .	. .	383	. .	374	375	. .	380	. .	. .	. .	. .	378	. .
Fe	7	7	. .	⊙″	5397	350	346	. .	351	343	. .	353	343	. .	. .	. .	348	. .	341	344	. .	343	*346*	. .	319	. .	346	319
Fe	7	7	. .	⊙″	5405	984	988	. .	991	983	985	992	991	. .	. .	. .	989	972	992	990	. .	987	*987*	. .	979	. .	987	979

---

* The correction for this series is not by theory but by a smooth curve through standards 5788 and 5791.

† This double E line measured .077 by another short series.

‡ The difference of this "1474" line measured accurately .146 by Crew and .141 by Rowland. The coincidences with Fe and Co are very doubtful, the Co line coming more nearly between the two than coinciding with either.

§ A companion on red side.

‖ Co line near about .1 to the red.

¶ Ca line measured.

	Intensity in Arc	Intensity in Sun	Nature in Arc	Kind of Standard		St	p	q	c	C	R	Pl 8 ⊙55 III ⊙41 IV	Pl 9 ⊙55 III ⊙41 IV	Pl 10 ⊙57 III ⊙43 IV	⊙M 52 II		⊙M 56 II		Substandard	M 56 I	M	Mean	
						⊙	⊙	⊙	⊙	⊙	⊙	R a ⊙	R a ⊙	R a ⊙	La J c ⊙	Ca J c ⊙	Ca J c ⊙	Ca J c M	⊙	Sr J c M		⊙	M
Cr	10	5	R	⊙″	5410	. .	. .	992	. .	007	007	. .	. .	. .	. .	999	995	. .	. .	. .	. .	000	. .
Fe, Va	4,4	6	. .	⊙″	5415	418	416	425	. .	420	422	418	423	. .	433	422	414	. .	. .	. .	. .	421	. .
Va, Fe	3,5	7	. .	⊙″	5424	281	276	290	. .	283	387	282	292	. .	. .	. .	281	. .	. .	. .	. .	284	. .
Fe	5	6	. .	⊙″	5434	. .	741	733	. .	752	742	750	741	. .	. .	. .	736	. .	. .	725	. .	742	725
Fe	7	7	. .	⊙″	5447	. .	132	117	. .	147	126	100	159	. .	. .	. .	129	. .	*130*	116	. .	130	116
Fe, ?	. .	3	. .	⊙	5455	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	666	. .	. .	. .	. .	666	. .
						. .	. .	759	739	782	766	755	754	. .	. .	. .	. .	. .	. .	. .	. .	759	. .
Fe	6	6	. .	⊙	5455	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	826	. .	. .	. .	. .	826	. .
Ni	3	1	. .	⊙′	5462	. .	721	. .	760	735	735	. .	. .	. .	. .	. .	707	. .	. .	. .	. .	732	. .
Fe	3	4	. .	⊙″	5463	. .	175	. .	164	185	175	175	174	. .	. .	. .	169	. .	. .		. .	174	. .
Fe	3	4	. .	⊙″	5463	. .	494	480	484	508	484	497	504	. .	. .	. .	491	. .	. .	. .	. .	493	. .
Fe	3	3	. .	⊙″	5466	. .	607	579	602	633	618	612	601	. .	. .	. .	608	. .	. .	. .	. .	608	. .
Ni	8	4	R	⊙″	5477	. .	135	102	. .	146	124	133	127	. .	. .	. .	128	. .	. .	. .	. .	128	. .
Fe	2	3	. .	⊙′	5487	. .	977	. .	. .	. .	962	. .	. .	. .	. .	. .	964	. .	. .	. .	. .	968	. .
Fe	3	4	. .	⊙″	5497	. .	735	727	. .	748	712	. .	723	. .	. .	. .	739	. .	. .	. .	. .	731	. .
Fe	5	4	. .	⊙″	5501	. .	688	680	. .	704	676	. .	676	. .	. .	. .	687	. .	. .	. .	. .	685	. .
Fe	5	5	. .	⊙″	5507	. .	001	990	. .	018	995	. .	994	. .	. .	. .	004	. .	. .	. .	. .	000	. .
Ca	5	4	N	⊙″	5513	. .	201	192	. .	222	203	. .	203	. .	. .	. .	203	127	. .	. .	. .	207	127
Mg	10	7	. .	⊙″	5528*	. .	643	631	. .	653	623	. .	630	. .	. .	. .	634	. .	. .	. .	672	636	672
Fe	. .	2	. .	⊙″	5535	. .	066	067	. .	086	095	. .	057	. .	. .	. .	064	. .	. .	. .	. .	073	. .
Fe	3	2	. .	⊙″	5543	. .	422	. .	400	424	445	. .	407	. .	. .	. .	410	. .	. .	. .	. .	418	. .
Fe	3	2	. .	⊙″	5544	. .	162	123	155	171	167	. .	167	. .	. .	. .	159	. .	. .	. .	. .	158	. .
Fe	4	3	. .	⊙″	5555	. .	123	103	. .	119	115	. .	110	. .	. .	. .	108	. .	. .	. .	. .	113	. .
Fe	6	5	. .	⊙″	5569	. .	853	836	. .	853	850	. .	850	. .	. .	. .	846	. .	. .	. .	. .	848	. .
Fe	5	4	. .	⊙″	5576	. .	325	. .	. .	315	321	. .	312	. .	. .	. .	324	. .	*319*	. .	. .	319	. .
Ca	6	4	. .	⊙″	5582	. .	207	175	. .	195	200	. .	193	197	. .	. .	196	203	. .	204	. .	195	204
Ca	10	6	R	⊙″	5588	. .	991	970	. .	984	972	. .	976	982	. .	. .	983	975	*979*	979	. .	980	977
Ca	5	4	. .	⊙″	5590	. .	. .	. .	. .	350	334	. .	. .	. .	. .	. .	342	348	. .	355	. .	342	352
Ca	7	5	R	⊙	5594	. .	. .	. .	. .	711	682	. .	. .	. .	. .	. .	691	685	. .	693	. .	695	689
Fe	3	2	. .	⊙′	5598	. .	. .	. .	. .	528	581	. .	. .	. .	. .	. .	. .	. .	. .	563	. .	555	563
Ca	7	4	. .	⊙′	5598	. .	. .	. .	. .	715	715	. .	. .	. .	. .	. .	715	708	. .	715	. .	715	712
Ca	5	4	. .	⊙″	5601	. .	. .	. .	. .	501	495	. .	. .	. .	. .	. .	506	512	. .	491	. .	501	502
Fe	2	2																					
Ca	6	t 4	. .	⊙′	5603†	097	114	090	. .	108	089	. .	101	098	. .	. .	081	. .	. .	. .	. .	097	. .
Fe	5	4																					
Fe	2	2	. .	⊙′	5615	528	530	510	. .	511	547	. .	524	531	. .	. .	527	. .	. .	. .	. .	526	. .

* This Mg. line is shaded to one side with much Mg. in the arc. The solar line corresponds to the extreme edge of this band-like line.

† Wave length of components about as follows: 5603.00, 5603.06, 5603 17.

	Intensity in Arc	Intensity in Sun	Kind of Standard				188	p	q	o	c	C	R	h	Pl 16 ⊙59 II ⊙39 III	Pl 17 ⊙59 II ⊙39 III		Pl 18 ⊙59 II ⊙39 III	Pl 9 ⊙55 III ⊙41 IV	Pl 10 ⊙57 III ⊙43 IV	Pl 11 ⊙59 III ⊙44 IV	⊙M 56 II	M	Mean	
					⊙	⊙		⊙	⊙	⊙	⊙	⊙	⊙	⊙	R a ⊙	R a ⊙	R a ⊙	R a ⊙	R a ⊙	R a ⊙	R a ⊙	Ca J c ⊙	J M	⊙c	M
Fe	2	6	⊙″	5615	. .	879	. .	877	880	. .	. .	880	872	. .	. .	. .	. .	. .	886	878	. .	881	. .	879	. .
Fe	2	2	⊙″	5624	254	252	258	244	. .	. .	248	270	268	. .	. .	. .	. .	. .	239	246	. .	248	. .	253	. .
Fe, Va	5, 2	4	⊙″	5624	764	766	756	769	798	762	766	772	744	. .	. .	. .	. .	. .	774	770	. .	771	. .	768	. .
Fe	2	3	⊙″	5634	. .	. .	. .	. .	. .	167	. .	158	173	. .	. .	. .	. .	. .	. .	. .	. .	169	. .	167	. .
Fe	2	3	⊙″	5641	. .	661	. .	664	664	. .	. .	647	667	. .	. .	. .	. .	. .	661	660	. .	666	. .	661	. .
Si	. .	2	⊙	5645	. .	. .	. .	830	810	. .	. .	833	841	. .	. .	. .	. .	. .	817	872	. .	840	. .	835	. .
Fe	2	4	⊙′	5655	. .	. .	. .	716	709	. .	. .	695	706	. .	. .	. .	. .	. .	702	710	. .	714	. .	707	. .
Y	1	4	⊙″	5658	. .	. .	. .	097	. .	093	. .	106	104	. .	. .	. .	. .	. .	089	086	. .	100	. .	096	. .
Fe	3	5	⊙″	5662	. .	. .	. .	756	738	. .	. .	739	756	. .	. .	. .	. .	. .	740	736	. .	747	. .	745	. .
Ti	3	2	⊙	5675	. .	. .	. .	669	642	. .	. .	640	650	. .	. .	. .	. .	. .	. .	638	. .	647	. .	648	. .
Fe	2	3	⊙″	5679	. .	. .	. .	255	. .	251	. .	244	251	. .	. .	. .	. .	. .	. .	243	. .	248	. .	249	. .
Na	3	4	⊙″	5682	. .	. .	. .	867	856	862	. .	859	866	. .	. .	. .	. .	. .	. .	853	. .	866	. .	861	. .
Na	. .	6	⊙″	5688	. .	. .	. .	447	. .	. .	. .	418	431	. .	. .	. .	. .	. .	. .	434	. .	439	. .	434	. .
Fe	4	5	⊙″	5701	. .	. .	. .	784	765	. .	. .	738	783	. .	. .	. .	. .	. .	. .	764	. .	777	. .	769	. .
Si	. .	5	⊙″	5708	. .	. .	. .	. .	. .	. .	. .	595	639	. .	. .	. .	. .	. .	. .	. .	. .	625	. .	620	. .
Fe	. .	6	⊙	5709	. .	. .	. .	645	. .	623	. .	583	623	. .	. .	. .	. .	. .	. .	. .	. .	606	. .	616	. .
Ni	5	5	⊙	5709	. .	. .	. .	767	. .	770	. .	729	769	. .	. .	. .	. .	. .	. .	749	. .	776	. .	760	. .
Mg	. .	. .	M	5711*	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	374	. .	374
Ni, Fe, Ti	5, 3	5	⊙″	5715	. .	. .	. .	318	304	311	. .	293	332	. .	. .	. .	292	. .	. .	310	. .	311	. .	309	. .
Fe	. .	5	⊙″	5731	. .	. .	. .	003	954	967	. .	967	989	. .	. .	. .	976	. .	. .	945	. .	984	. .	973	. .
Fe	. .	3	⊙	5742	. .	. .	. .	091	056	. .	. .	050	068	060	. .	. .	064	. .	. .	070	. .	072	. .	066	. .
Fe	. .	4	⊙″	5752	. .	. .	. .	268	247	. .	. .	256	262	265	. .	. .	254	. .	. .	251	. .	255	. .	257	. .
Fe	. .	5	⊙″	5753	. .	. .	. .	350	341	. .	. .	328	336	350	. .	. .	342	. .	. .	336	. .	350	. .	342	. .
Ni, ?	5,	5	⊙″	5754	. .	. .	. .	900	. .	. .	. .	868	892	888	. .	. .	874	. .	. .	881	. .	883	. .	884	. .
Fe	. .	7	$\odot_1$	5763†	. .	. .	. .	228	216	. .	. .	208	216	. .	. .	. .	. .	. .	. .	202	. .	220	. .	215	. .
Si	. .	5	⊙″	5772	. .	. .	. .	371	362	. .	. .	358	343	. .	. .	. .	. .	. .	. .	. .	. .	366	. .	360	. .
Fe	. .	5	⊙″	5775	. .	. .	. .	312	297	299	. .	300	316	. .	. .	. .	. .	. .	. .	308	. .	299	. .	304	. .
Cu?, Co?	. .	d 7	⊙″	5782	. .	. .	. .	341	364	. .	. .	342	360	. .	. .	. .	. .	. .	. .	339	326	349	. .	346	. .
Cr	6	4	⊙″	5784	. .	. .	. .	088	. .	077	. .	073	108	. .	. .	. .	075	. .	. .	085	063	078	. .	081	. .
Cr	7	5	⊙″	5788	. .	. .	134	148	. .	140	. .	131	152	. .	124	136	139	. .	. .	140	126	142	. .	136	. .
Cr, Fe	10,	d 7	⊙″	5791	. .	. .	202	208	206	202	. .	205	231	232	196	193	205	. .	. .	202	208	203	. .	207	. .
		4	⊙″	5798	. .	. .	. .	. .	. .	. .	. .	095	123	. .	065	067	076	088	. .	. .	. .	093	. .	087	. .
Fe	. .	4	⊙″	5798	. .	. .	. .	389	410	. .	. .	390	417	. .	. .	. .	398	. .	. .	391	. .	404	. .	400	. .
Ni	7	5	⊙″	5805	. .	. .	. .	441	437	. .	. .	440	481	. .	. .	. .	440	. .	. .	. .	. .	446	. .	448	. .
Fe	. .	5	⊙″	5806	. .	. .	. .	. .	. .	. .	. .	947	965	960	. .	. .	950	. .	. .	. .	. .	946	. .	954	. .
Fe	. .	5	⊙″	5809	. .	. .	. .	437	. .	. .	. .	445	456	438	426	435	442	437	. .	422	438	439	. .	437	. .

* This Mg. line is shaded to one side especially with much Mg. in the arc. The corresponding solar line is at 5711, 318.

† Companion to violet.

	Intensity in Arc	Intensity in Sun	Kind of Standard		St	St	188	p	q	o	c	C	R	C	Pl 20 62 I 31 II	Pl 16 59 II 39 III	Pl 17 59 II 39 III		Pl 18 59 II 39 III	Pl 10 57 III 43 IV	Pl 11 59 III 44 IV	$\odot$ M 56 II	Substandard	Mean	
					$\odot$	$\odot$	$\odot$	$\odot$	$\odot$	$\odot$	$\odot$	$\odot$	$\odot$	$\odot$	R a $\odot$	R a $\odot$	R a $\odot$		R a $\odot$	R a $\odot$	R a $\odot$	Ca J c $\odot$	$\odot$	$\odot$	M
Fe	. .	6	$\odot_1$	5816*	. .	. .	. .	584	594	. .	. .	589	609	. .	. .	591	597	603	605	579	586	600	. .	594	. .
Ni	3	3	$\odot'$	5831	. .	. .	. .	829	827	. .	. .	822	862	. .	. .	. .	. .	819	. .	. .	. .	. .	. .	832	. .
Ba	10	5	$\odot''$	5853	. .	. .	. .	905	919	. .	. .	903	889	909	905	900	896	904	904	. .	896	. .	. .	903	. .
Ca	10	7	$\odot'$	5857	. .	. .	667	664	. .	. .	. .	679	671	681	673	670	665	679	675	. .	669	. .	. .	672	. .
Fe	. .	6	$\odot''$	5859	. .	812	811	802	806	. .	. .	820	815	812	813	804	807	814	807	. .	. .	. .	. .	810	. .
Fe	. .	6	$\odot''$	5862	582	583	581	568	. .	. .	. .	587	566	581	584	578	574	584	588	. .	585	. .	. .	580	. .
Fe	. .	6	$\odot_1$	5884†	. .	. .	. .	. .	. .	. .	. .	061	048	035	051	048	048	043	040	. .	058	. .	. .	048	. .
A	. .	1–5	$\odot_1$	5889	. .	. .	. .	. .	. .	862	. .	841	853	876	840	. .	. .	847	. .	. .	. .	. .	. .	854	. .
Na	. .	15	$\odot'$	5890	184	182	184	193	181	190	181	190	158	184	185	185	176	184	170	. .	186	. .	*182*	182	. .
Ni	. .	4	$\odot$	5893	. .	. .	. .	090	103	. .	. .	105	083	104	088	097	101	098	094	. .	117	. .	. .	098	. .
Na	. .	10	$\odot''$	5896	157	157	148	165	165	151	141	159	137	138	146	158	162	155	160	. .	165	. .	*154*	154	. .
A, Fe	. .	d,4	$\odot_1$	5898	. .	. .	392	392	. .	. .	. .	416	377	408	396	. .	. .	377	. .	. .	398	. .	. .	395	. .
A, Fe	. .	d	$\odot_1$	5901	. .	. .	. .	706	. .	. .	. .	720	682	705	674	674	643	673	676	. .	657	. .	. .	681	. .
Fe	. .	5	$\odot''$	5905	. .	894	. .	893	897	. .	. .	896	906	885	887	891	902	894	894	. .	897	. .	. .	895	. .
Fe, ?	. .	d,4,5	$\odot''$	5914‡	386	386	. .	382	. .	381	391	370	382	387	379	385	393	378	395	. .	387	. .	. .	384	. .
Fe	. .	5	$\odot''$	5916	. .	471	489	473	. .	. .	481	460	496	478	466	474	473	470	478	. .	466	. .	. .	475	. .
A	. .	4	$\odot''$	5919	. .	. .	. .	866	. .	861	. .	837	864	. .	849	853	862	850	. .	. .	849	. .	. .	855	. .
Fe	. .	6	$\odot''$	5930	. .	. .	. .	406	427	. .	. .	400	436	402	400	408	406	402	409	. .	414	. .	. .	410	. .
Fe	. .	6	$\odot''$	5934	. .	. .	. .	883	881	. .	. .	866	913	. .	869	880	885	880	871	. .	902	. .	. .	883	. .
Si	. .	6	$\odot''$	5948	. .	. .	. .	744	775	742	. .	763	777	767	747	758	773	760	768	. .	. .	. .	. .	761	. .
Fe	. .	5	$\odot''$	5956	. .	. .	. .	932	919	. .	. .	927	949	. .	904	918	922	920	930	. .	. .	. .	. .	925	. .
Fe	. .	4	$\odot''$	5975	. .	. .	. .	576	585	. .	. .	572	589	. .	558	566	571	570	595	. .	. .	. .	. .	576	. .
Fe	. .	5	$\odot$	5977	. .	. .	. .	004	014	. .	. .	996	046	994	993	999	000	998	009	. .	. .	. .	. .	005	. .
A	. .	. .		5977	. .	. .	. .	. .	. .	. .	. .	. .	254	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	254	. .
Fe	. .	6	$\odot''$	5985	. .	. .	. .	037	061	. .	. .	035	058	. .	028	. .	. .	. .	. .	. .	. .	. .	. .	044	. .
Fe	. .	6	$\odot''$	5987	. .	. .	. .	287	293	270	. .	282	312	. .	273	. .	. .	. .	. .	. .	. .	. .	. .	286	. .
Fe	. .	6	$\odot''$	6003	. .	. .	. .	244	259	. .	. .	231	276	232	228	. .	. .	. .	. .	. .	. .	. .	. .	245	. .
Fe	. .	4	$\odot''$	6008	. .	. .	. .	. .	. .	. .	. .	. .	215	. .	177	. .	. .	. .	. .	. .	. .	. .	. .	196	. .
Fe	. .	6	$\odot''$	6008	. .	. .	. .	768	776	. .	. .	777	810	. .	778	. .	. .	. .	. .	. .	. .	. .	. .	782	. .
Mn	10	6	$\odot''$	6013	. .	. .	. .	702	. .	. .	. .	737	730	. .	700	. .	. .	. .	. .	. .	. .	. .	. .	717	. .
Mn	10	6	$\odot''$	6016	. .	. .	. .	862	856	841	. .	873	887	826	847	. .	. .	. .	. .	. .	. .	. .	. .	856	. .
?, Fe	. .	d,3,5	$\odot_1$	6020§	. .	. .	. .	350	345	. .	. .	342	366	. .	330	. .	. .	. .	. .	. .	. .	. .	. .	347	. .
Mn	10	6		6022	. .	. .	. .	019	. .	. .	. .	021	025	013	007	. .	. .	. .	. .	. .	. .	. .	. .	017	. .
Fe	. .	6	$\odot'$	6024	. .	. .	. .	273	288	263	. .	295	290	279	270	. .	. .	. .	. .	. .	. .	. .	. .	280	. .
Fe	. .	4	$\odot''$	6027	. .	. .	. .	268	258	. .	. .	276	262	263	260	. .	. .	. .	. .	. .	. .	. .	. .	265	. .
Fe	. .	4	$\odot''$	6042	. .	. .	. .	296	326	310	. .	344	335	307	305	. .	. .	. .	. .	. .	. .	. .	. .	316	. .

---

* Companion to violet.

† An atmospheric line is very near this to red. Distance about .08.

‡ Components about .1 apart.

§ Components about .2 apart.

	Intensity in Arc	Intensity in Sun.	Kind of Standard		188	196	p	q	o	c	C	R	h	i	*a*	Pl 20 ⊙62 I ⊙31 II	M	Mean	
					⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	J c ⊙	J ⊙	⊙	M
Fe	. .	5	⊙″	6056	. .	. .	210	245	215	. .	246	260	. .	. .	. .	214	. .	232	. .
Fe	. .	7	⊙″	6065	729	. .	704	705	692	707	720	731	701	695	. .	698	. .	708	. .
Fe	. .	5	⊙″	6078	719	. .	701	713	703	698	731	720	704	698	. .	700	. .	709	. .
Fe	. .	3	⊙″	6079	244	. .	200	. .	207	212	240	240	220	231	. .	211	. .	223	. .
Fe	. .	. .	⊙′	6102	. .	. .	. .	. .	. .	. .	. .	415	. .	401	. .	. .	. .	408	. .
Ca	10	6	⊙″	6102	. .	. .	. .	934	. .	. .	938	973	948	922	. .	932	. .	941	. .
Fe, ?	. .	d, 4, 1	$\odot_1$	6103*	. .	. .	385	. .	. .	. .	444	458	. .	440	. .	420	. .	449	. .
Li	. .	. .	M	6103	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	812	. .	812
Ni	5	6	⊙″	6108	. .	. .	. .	333	339	. .	333	353	. .	. .	. .	333	. .	338	. .
Ni	4	4	⊙′	6111	. .	. .	274	. .	285	. .	287	300	. .	. .	. .	287	. .	287	. .
Fe	.5	6	⊙″	6116	. .	. .	406	. .	420	. .	414	424	. .	. .	. .	411	. .	415	. .
Ca	15	9	⊙″	6122	. .	. .	424	406	421	. .	427	464	436	416	. .	429	. .	428	. .
Fe	. .	8	⊙′	6136	. .	. .	829	832	836	. .	813	857	. .	. .	. .	834	. .	834	. .
Fe, Ba	,15	7	⊙″	6141	. .	. .	937	929	. .	. .	918	945	930	. .	. .	934	. .	934	. .
Na	. .	3	⊙″	6154	. .	. .	. .	. .	405	. .	424	465	. .	. .	. .	. .	. .	431	. .
Na	. .	5	⊙″	6160	. .	. .	. .	. .	. .	. .	948	991	. .	. .	. .	. .	. .	970	. .
Ca	15	10	⊙″	6162	. .	. .	385	391	. .	. .	380	375	377	. .	. .	387	. .	383	. .
Ca	6	6	⊙″	6169	. .	. .	. .	. .	. .	. .	245	274	. .	. .	. .	. .	. .	260	. .
Ca	7	7	⊙″	6169	. .	. .	772	771	. .	. .	760	797	. .	. .	. .	776	. .	775	. .
Fe	. .	6	⊙″	6173	. .	. .	545	. .	. .	. .	540	581	548	. .	. .	554	. .	554	. .
Ni	5	6	⊙″	6177	. .	. .	011	023	. .	. .	026	052	. .	. .	. .	027	. .	028	. .
Fe	. .	6	⊙″	6180	. .	. .	418	410	. .	. .	407	441	. .	. .	. .	418	. .	419	. .
Ni	4	6	⊙″	6191	. .	. .	363	. .	. .	. .	380	432	381	430	. .	398	. .	397	. .
Fe	. .	7	⊙″	6191	. .	. .	777	767	. .	. .	764	788	759	754	. .	783	. .	770	. .
Fe	. .	6	⊙″	6200	. .	. .	524	542	528	. .	520	557	522	. .	. .	535	. .	533	. .
Fe	. .	6	⊙″	6213	. .	. .	640	651	. .	. .	640	674	628	. .	. .	643	. .	646	. .
Fe	. .	6	⊙″	6219	. .	. .	497	499	489	. .	473	522	480	. .	. .	494	. .	493	. .
Fe, Va	,6	7	⊙″	6230	959	. .	938	949	. .	938	914	958	957	946	. .	951	. .	946	. .
		4	⊙″	6237	. .	. .	525	. .	517	. .	515	537	. .	. .	. .	552	. .	529	. .
Fe	. .	7	⊙″	6246	. .	. .	527	540	528	. .	514	536	. .	. .	. .	534	. .	530	. .
Fe	. .	7	⊙″	6252	. .	. .	766	774	. .	. .	761	786	793	. .	. .	776	. .	776	. .
Fe	. .	7	⊙″	6284	. .	. .	446	456	. .	. .	443	455	464	. .	. .	459	. .	454	. .
Ni, Fe	7,	6	⊙″	6256	. .	. .	575	570	. .	. .	561	586	. .	. .	. .	577	. .	574	. .
Ti	5	2	⊙″	6261	. .	296	310	. .	. .	. .	320	334	313	. .	. .	324	. .	316	. .
Fe	. .	5	⊙″	6265	. .	333	342	346	355	. .	343	364	344	. .	. .	349	. .	347	. .
Fe	. .	3	⊙″	6270	. .	. .	436	437	445	. .	413	460	436	. .	. .	445	. .	439	. .
A	. .	4	⊙″	6278	. .	. .	285	279	. .	. .	274	305	290	. .	298	293	. .	289	. .

* Components about .1 apart.

	Intensity in Arc	Intensity in Sun	Nature in Arc	Kind of Standard		St	St	188	196	p	q	O	c	C	R	h	i	*a*	t	Pl 20 ⊙62 ⊙31		Pl 21	Mean	
										⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙			J c ⊙		J c ⊙	⊙	M
A	. .	2	. .	⊙′	6281	. .	. .	. .	. .	373	. .	379	. .	365	. .	380	. .	373	. .	376	. .	. .	374	. .
A	. .	2	. .	⊙′	6289	. .	. .	. .	. .	. .	. .	. .	. .	603	. .	. .	635	595	. .	598	. .	. .	608	. .
A	. .	3	. .	⊙	6293*	. .	. .	. .	. .	168	132	. .	. .	147	. .	. .	. .	153	. .	160	. .	. .	152	. .
A	. .	3	. .	⊙″	6296	. .	147	. .	. .	153	119	. .	. .	137	. .	. .	. .	137	. .	172	. .	. .	144	. .
Fe	. .	7	. .	⊙″	6301	. .	714	. .	. .	. .	725	. .	. .	715	724	. .	. .	721	. .	712	. .	. .	719	. .
Ni	6	4	. .	⊙″	6314	. .	874	. .	. .	. .	. .	. .	. .	870	870	873	. .	871	. .	884	. .	. .	874	. .
Fe	. .	3	. .	$\odot_1$	6315†	. .	. .	. .	. .	. .	. .	. .	. .	545	535	. .	. .	524	. .	558	. .	. .	541	. .
Fe, (Ca)	. .	6	. .	⊙″	6318	241	244	245	234	232	253	245	240	248	244	229	. .	246	. .	241	. .	. .	242	. .
Fe	. .	5	. .	⊙″	6322	912	909	921	917	900	. .	905	917	917	903	917	. .	914	. .	908	. .	. .	912	. .
Fe	. .	6	. .	⊙″	6338	. .	549	553	. .	555	546	550	551	542	554	556	540	. .	. .	553	. .	. .	550	. .
Fe	. .	6	. .	⊙″	6337	. .	043	030	. .	041	043	051	028	041	042	043	048	. .	. .	047	. .	. .	042	. .
Fe	. .	5	. .	⊙″	6344	. .	. .	. .	. .	383	356	. .	. .	370	363	. .	. .	. .	. .	376	. .	. .	370	. .
Fe	. .	5	. .	⊙	6355†	. .	. .	. .	. .	258	270	253	. .	250	264	248	. .	. .	. .	267	. .	. .	259	. .
Fe	. .	6	. .	⊙″	6358	. .	. .	. .	. .	897	907	914	. .	893	897	908	. .	. .	. .	899	. .	. .	902	. .
Ni	5	2	. .	⊙	6378	. .	. .	. .	. .	. .	. .	. .	. .	. .	450	. .	472	. .	. .	. .	. .	. .	461	. .
Fe	. .	4	. .	⊙″	6380	. .	. .	. .	. .	. .	965	. .	. .	938	930	. .	961	. .	. .	960	. .	. .	951	. .
Fe	. .	7	. .	⊙″	6393	. .	. .	. .	. .	827	824	809	. .	801	800	837	818	. .	. .	828	. .	. .	818	. .
Fe	. .	8	. .	⊙′	6400	. .	. .	. .	. .	. .	. .	. .	. .	170	213	. .	199	. .	. .	219	. .	. .	200	. .
Fe	. .	3	. .	⊙′	6400	. .	. .	. .	. .	. .	. .	. .	. .	464	486	526	527	. .	. .	542	. .	. .	509	. .
Fe	. .	6	. .	⊙″	6408	. .	. .	. .	. .	246	. .	250	. .	205	218	243	220	. .	. .	237	. .	. .	231	. .
Fe	. .	7	. .	⊙″	6411	. .	. .	. .	864	878	892	861	. .	843	837	872	859	. .	. .	872	. .	. .	864	. .
Fe	. .	5	. .	⊙″	6420	. .	. .	. .	180	. .	. .	175	. .	150	153	181	184	. .	. .	177	. .	. .	171	. .
Fe	. .	6	. .	⊙	6421†	. .	. .	. .	593	580	577	583	. .	545	553	555	568	. .	. .	571	. .	. .	569	. .
Fe	. .	6	. .	⊙″	6431	. .	. .	. .	074	065	063	078	. .	030	033	078	064	. .	. .	084	. .	. .	063	. .
Cd	. .	. .	. .	M	6438	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	680	. .	. .	680
Ca	10	7	. .	⊙″	6439	. .	. .	. .	307	312	314	300	. .	277	274	301	300	. .	. .	297	. .	314	298	. .
Ca	5	6	. .	⊙″	6450	. .	. .	. .	057	038	033	. .	. .	000	015	. .	. .	. .	. .	. .	. .	049	029	. .
Ca, Fe	10	$d\begin{cases}9\\3\end{cases}$	. .	⊙″	6462	. .	. .	. .	. .	852	876	. .	. .	837	801	822	819	. .	. .	838	. .	884	835	. .
Ca	5	5	. .	⊙″	6471	. .	. .	. .	. .	892	894	. .	. .	865	870	. .	. .	. .	. .	885	. .	911	881	. .
A	. .	1	. .	⊙	6480	. .	. .	. .	. .	285	. .	. .	. .	250	259	. .	. .	. .	. .	260	. .	267	264	. .
	. .	4	. .	⊙″	6482	. .	. .	. .	. .	106	111	. .	. .	070	072	125	110	. .	. .	096	. .	100	099	. .
Ca	8	6	. .	⊙″	6494	. .	. .	. .	034	002	019	. .	. .	962	982	997	003	. .	. .	011	. .	012	001	. .
Fe	. .	7	. .	⊙″	6495	. .	. .	. .	. .	214	226	. .	. .	186	192	202	222	. .	. .	221	. .	224	209	. .
Ca	5	5	. .	⊙″	6499	. .	. .	. .	. .	881	. .	875	. .	852	864	870	881	. .	864	879	. .	885	871	. .
	6	4	. .	⊙	6516	. .	. .	. .	. .	311	323	. .	. .	292	317	. .	. .	. .	313	340	. .	. .	315	. .
Fe	. .	4	. .	⊙′	6518	. .	. .	. .	. .	609	602	578	. .	590	578	599	596	. .	603	596	. .	. .	594	. .

* Companion near to violet.

† Companion near to red.

	Intensity in Arc	Intensity in Sun	Nature in Arc	Kind of Standard		St	St	u	196	p	q	O	C	R	h	i	C′	t	Pl 20 ⊙62 I ⊙31 II	Pl 21	M	Pl 22	Pl 23	Mean	
								⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙		J c ⊙	J c ⊙	J	J c ⊙	J c ⊙	⊙	M
		1	. .	⊙	6532	. .	. .	. .	. .	576	. .	. .	517	563	567	. .	. .	. .	509	557	. .	. .	. .	546	. .
		3	. .	⊙″	6534	. .	172	. .	. .	179	150	185	171	169	166	191	. .	. .	173	183	. .	. .	. .	173	. .
Ti, Fe	3	6	. .	⊙″	6546	. .	483	. .	495	. .	469	. .	481	492	484	501	. .	. .	481	473	. .	. .	. .	486	. .
		2	. .	⊙	6552	. .	. .	. .	. .	. .	. .	. .	800	845	835	. .	. .	870	849	. .	. .	. .	. .	840	. .
H	. .	30	. .	⊙″	6563	049	047	. .	072	051	086	040	044	043	063	031	. .	065	. .	060	. .	. .	. .	054	. .
Fe	. .	6	. .	⊙″	6569	461	462	. .	455	460	454	. .	471	471	461	451	. .	. .	468	461	. .	. .	. .	461	. .
		1	. .	⊙	6572	. .	. .	. .	. .	336	. .	324	276	318	. .	. .	. .	. .	. .	298	. .	. .	. .	312	. .
		2	. .	⊙	6574	. .	. .	. .	. .	473	. .	. .	469	490	. .	. .	. .	. .	. .	466	. .	. .	. .	477	. .
Fe	. .	4	. .	$\odot_1$	6575*	. .	. .	. .	. .	203	. .	153	165	181	172	197	. .	. .	. .	{053 275}	. .	. .	. .	179	. .
Fe	. .	5	. .	⊙″	6593	. .	167	. .	143	160	. .	166	153	168	168	173	. .	152	. .	156	. .	. .	. .	161	. .
Fe	. .	4	. .	⊙″	6594	. .	116	. .	097	113	109	121	128	130	114	113	. .	110	. .	113	. .	. .	. .	115	. .
Fe	. .	4	. .	⊙″	6609	. .	. .	. .	320	360	346	. .	366	369	370	. .	. .	346	. .	351	. .	. .	. .	354	. .
Fe	. .	3	. .	⊙	6633	. .	. .	. .	. .	981	991	. .	985	014	. .	. .	. .	991	. .	996	. .	. .	. .	992	. .
Ni	5	5	. .	⊙″	6643	. .	. .	. .	. .	877	873	880	880	902	877	917	. .	872	. .	875	. .	. .	. .	882	. .
		1	. .	⊙″	6663	. .	. .	. .	. .	. .	. .	. .	513	537	. .	. .	. .	. .	. .	473	. .	. .	. .	525	. .
Fe	. .	4	. .	⊙″	6663	. .	. .	. .	. .	677	693	. .	693	719	. .	. .	. .	. .	. .	694	. .	. .	. .	696	. .
Fe	. .	5	. .	⊙″	6678	. .	. .	. .	. .	231	241	238	244	280	232	227	. .	247	. .	237	. .	. .	. .	232	. .
		2	. .	⊙	6703	. .	. .	793	. .	801	. .	807	820	823	816	830	. .	. .	. .	818	. .	812	. .	813	. .
		3	. .	⊙	6705	. .	. .	334	. .	337	347	366	343	372	352	372	. .	. .	. .	358	. .	850	. .	353	. .
Li	. .	. .	. .	M	6708	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	090	. .	. .	. .	090
Ca	10	4	. .	⊙	6717*	. .	. .	. .	. .	928	929	924	944	951	926	923	. .	. .	. .	935	. .	942	. .	934	. .
		3	. .	⊙	6722	. .	090	. .	. .	080	101	096	112	085	101	. .	. .	. .	. .	086	. .	093	. .	095	. .
Fe	. .	3	. .	⊙	6726	. .	. .	. .	. .	. .	924	. .	926	922	922	. .	. .	. .	. .	921	. .	920	. .	923	. .
Fe	. .	4	. .	⊙″	6750	409	409	435	. .	409	408	419	403	424	396	418	. .	. .	. .	. .	. .	409	. .	412	. .
Fe	. .	2	. .	⊙′	6752	. .	964	. .	. .	982	. .	944	957	963	. .	. .	. .	. .	. .	. .	. .	960	. .	962	. .
Ni	5	4	. .	⊙″	6768	. .	. .	. .	. .	021	104	082	013	032	030	037	. .	. .	. .	. .	. .	029	. .	044	. .
Ni	2	3	. .	⊙′	6772	. .	569	. .	. .	566	570	. .	560	567	570	561	. .	555	. .	. .	. .	567	. .	565	. .
Fe	. .	1	. .	⊙	6787	. .	. .	. .	. .	123	. .	154	157	. .	. .	. .	. .	. .	. .	. .	. .	116	. .	137	. .
Fe	. .	2	. .	⊙′	6807	. .	. .	. .	. .	. .	. .	. .	115	080	095	107	. .	. .	. .	. .	. .	103	. .	100	. .
Fe	. .	3	. .	⊙″	6810	. .	. .	. .	. .	517	523	. .	524	521	520	510	. .	. .	. .	. .	. .	521	. .	519	. .
Fe	. .	2	. .	⊙′	6820	. .	. .	. .	. .	613	. .	. .	610	601	. .	. .	. .	. .	. .	. .	. .	631	. .	614	. .
Fe	. .	2	. .	⊙′	6828	. .	. .	. .	. .	841	851	878	847	831	. .	. .	. .	. .	. .	. .	. .	851	. .	850	. .
Fe	. .	3	. .	⊙′	6841	. .	. .	. .	. .	598	593	. .	610	560	. .	. .	. .	. .	. .	. .	. .	596	. .	591	. .
Fe	. .	3	. .	⊙′	6843	. .	. .	. .	. .	908	. .	. .	900	909	. .	. .	. .	. .	. .	. .	. .	914	. .	908	. .
Fe	. .	3	. .	⊙′	6855	. .	. .	. .	. .	420	428	442	440	412	. .	. .	388	. .	. .	. .	. .	443	426	425	. .

* Companion near to violet.

	Intensity in Arc	Intensity in Sun	Kind of Standard		St	St	u	p	q	O	C	R	h	i	C′	t	Pl 22	Pl 23	Mean
							⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	J c ⊙	J c ⊙	⊙
A	. .	3	⊙′	6867	. .	. .	. .	435	. .	501	447	460	476	461	455	468	468	443	461
A	. .	3	⊙′	6867	. .	. .	. .	748	. .	837	771	795	796	785	825	799	832	818	800
A	. .	1	. .	6868	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	152	096	124
A	. .	d 6	. .	6868	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	393	393	393
A	. .	d {1 3	. .	6868	. .	. .	. .	. .	. .	. .	744	. .	. .	. .	. .	. .	786	808	779
A	. .	4	. .	6869 }	. .	. .	. .	. .	. .	. .	111	. .	. .	. .	161	. .	145	149	141
			⊙′		. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
A	. .	4	. .	6869 }	. .	. .	. .	. .	. .	. .	317	. .	. .	. .	369	. .	351	350	347
A	. .	d {4 4	⊙″	6870*	. .	. .	. .	196	209	185	160	201	. .	. .	157	194	186	189	186
A	. .	5	⊙′	6871	. .	. .	. .	. .	. .	. .	175	. .	. .	. .	192	. .	176	173	179
A	. .	5	⊙′	6871	. .	. .	. .	. .	. .	. .	486	. .	. .	. .	540	. .	538	544	527
A	. .	5	⊙″	6872	. .	. .	. .	. .	. .	. .	479	. .	. .	. .	528	. .	481	485	493
A	. .	5	⊙″	6873	. .	. .	. .	. .	. .	. .	050	. .	. .	. .	. .	. .	088	090	076
A	. .	5	⊙″	6874	. .	. .	. .	. .	. .	. .	021	. .	. .	. .	050	. .	040	044	039
A	. .	5	⊙″	6874	. .	. .	. .	. .	. .	. .	870	. .	. .	. .	876	. .	892	900	884
A	. .	5	⊙″	6875	. .	. .	. .	826	826	. .	819	. .	800	. .	843	835	824	836	826
A	. .	5	⊙″	6876	. .	. .	. .	. .	. .	. .	942	. .	960	. .	972	955	956	959	957
A	. .	5	⊙″	6877	. .	. .	. .	. .	. .	. .	865	. .	879	. .	882	872	884	887	878
A	. .	5	⊙″	6879	. .	. .	. .	297	. .	297	269	312	291	306	307	286	291	281	294
A	. .	3	⊙″	6880	. .	. .	. .	174	. .	187	150	191	160	224	154	160	177	177	176
Cr	1	1	. .	6881	. .	. .	. .	. .	. .	. .	932	. .	. .	. .	973	. .	991	984	970
Cr	2	1	. .	6882	. .	. .	. .	. .	. .	. .	755	. .	. .	. .	753	. .	796	783	772
Cr	3	1	. .	6883	. .	. .	. .	. .	. .	. .	327	. .	. .	. .	294	. .	335	317	318
A	. .	4	⊙″	6884	. .	. .	102	084	076	090	046	113	068	085	098	078	080	080	083
A	. .	5	⊙″	6886†	. .	. .	. .	002	. .	013	000	015	995	032	018	994	002	006	008
A	. .	5	⊙″	6886	. .	. .	. .	983	. .	001	972	017	974	980	988	971	989	991	987
A	. .	5	⊙″	6889	. .	. .	. .	. .	. .	. .	175	. .	. .	. .	224	. .	191	188	194
A	. .	5	⊙″	6890	. .	. .	. .	. .	. .	. .	136	. .	. .	. .	138	. .	144	151	149
A	. .	6	⊙″	6892	. .	. .	. .	. .	. .	. .	595	. .	. .	. .	629	. .	615	617	614
A	. .	6	⊙″	6893	. .	. .	. .	. .	. .	. .	537	. .	. .	. .	567	. .	564	570	559
A	. .	6	⊙″	6896	. .	. .	. .	. .	. .	307	274	. .	. .	. .	301	284	294	290	292
A	. .	6	⊙″	6897	. .	. .	. .	147	. .	226	183	. .	. .	. .	195	198	203	214	195
A	. .	6	⊙″	6900	. .	. .	. .	. .	. .	. .	182	. .	. .	. .	205	111	200	199	199
A	. .	6	⊙″	6901	. .	. .	. .	127	099	120	093	. .	. .	. .	106	. .	115	119	113

* Principal line in the head of B.

† First line in the tail of B.

	Intensity in Arc	Intensity in Sun	Kind of Standard		St	St	u	p	q	o	C	R	h	i	C′	t	Pl 22	Pl 23	Mean
							⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	J c ⊙	J c ⊙	⊙
A	. .	6	⊙″	6904	. .	. .	. .	. .	. .	. .	340	. .	. .	. .	378	. .	359	357	358
A	. .	6	⊙″	6905	. .	. .	. .	. .	. .	. .	255	. .	. .	. .	255	. .	274	269	263
A	. .	6	⊙″	6908	. .	. .	. .	. .	. .	. .	777	. .	. .	. .	791	. .	789	782	785
A	. .	6	⊙″	6909*	. .	. .	. .	668	683	689	661	. .	. .	. .	675	672	674	674	675
A	. .	5	⊙″	6913	. .	. .	. .	. .	. .	. .	436	. .	. .	. .	484	. .	449	446	454
A	. .	5	⊙″	6914	. .	. .	. .	. .	. .	. .	310	. .	. .	. .	. .	. .	338	337	328
Ni	5	3	⊙′	6914	. .	. .	. .	. .	. .	. .	806	. .	. .	. .	. .	. .	826	825	819
	. .	2	⊙′	6916	. .	. .	. .	. .	. .	. .	948	. .	. .	. .	981	. .	950	950	957
A	. .	4	⊙″	6918	. .	. .	. .	. .	. .	. .	356	. .	. .	. .	359	. .	371	366	363
A	. .	4	⊙″	6919*	. .	. .	. .	243	238	258	245	. .	. .	. .	241	237	250	244	245
A	. .	4	⊙″	6923*	. .	. .	. .	. .	. .	. .	533	563	564	. .	568	562	558	554	557
A	. .	4	⊙″	6924*	. .	. .	. .	423	418	421	417	432	399	. .	407	425	426	427	420
A	. .	2	⊙′	6928	. .	. .	. .	. .	. .	. .	947	. .	. .	. .	066	. .	982	974	992
A	. .	2	⊙′	6929	. .	. .	. .	870	868	. .	827	. .	. .	. .	802	827	836	833	838
A	. .	1	. .	6934	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	593	. .	680	666	646
A	. .	1	. .	6935	. .	. .	. .	. .	. .	. .	517	. .	. .	. .	551	. .	524	528	530
Awv	. .	7	⊙″	6947	. .	. .	. .	794	768	. .	772	797	781	753	786	. .	797	799	781
Awv	. .	$d\left\{\begin{matrix}1\\1\end{matrix}\right.$	. .	6953	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	903	. .	798	813	838
Awv	. .	7	⊙″	6956	. .	. .	730	684	706	731	688	705	693	694	693	. .	692	681	700
Awv	. .	3	. .	6959	. .	. .	. .	711	. .	731	704	701	704	709	705	. .	698	705	708
Awv	. .	6	. .	6961	. .	. .	554	515	501	529	520	519	511	515	505	. .	506	527	518
Awv	. .	. .	. .	6977	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	723	723
Awv	. .	2	. .	6978	. .	. .	. .	648	687	. .	655	625	. .	. .	. .	. .	. .	662	655
Awv	. .	6	. .	6986	. .	. .	. .	835	836	847	816	842	818	828	849	. .	. .	811	832
Awv	. .	6	. .	6989	. .	. .	. .	. .	. .	. .	228	265	239	237	241	. .	. .	232	240
Awv?	. .	. .	. .	6998	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	953	953
At?	. .	6	. .	6999	. .	. .	. .	177	. .	. .	186	. .	150	145	163	. .	. .	222	174
Awv	. .	6	. .	7000	. .	. .	. .	. .	. .	. .	139	140	. .	. .	. .	. .	. .	151	143
	. .	7	. .	7006	. .	. .	. .	138	164	. .	193	. .	. .	. .	143	. .	. .	159	160
Awv	. .	3	. .	7011	. .	. .	. .	567	. .	578	594	595	. .	. .	573	. .	. .	603	585
	. .	3	. .	7016	. .	. .	. .	. .	. .	. .	. .	275	249	283	285	. .	. .	304	279
	. .	8	. .	7016	. .	695	. .	672	693	. .	677	699	698	697	695	. .	. .	674	690
	. .	. .	. .	7023	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	225	225
Awv	. .	3	. .	7023	747	750	. .	. .	. .	. .	728	743	769	. .	745	. .	. .	748	747
	. .	3	. .	7024	. .	. .	. .	992	. .	. .	. .	. .	. .	. .	983	. .	. .	. .	988
	. .	. .	. .	7027	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	199	199
	. .	5	. .	7027	724	718	760	713	. .	. .	724	725	708	. .	706	. .	. .	748	726

* These lines were used as substandards for t.

	Intensity in Arc	Intensity in Sun	Kind of Standard		St	St	u ⊙	p ⊙	q ⊙	o ⊙	C ⊙	R ⊙	h ⊙	i ⊙	C′ ⊙	i′ ⊙	Pl 22 J c ⊙	Pl 23 J c ⊙	Mean ⊙
	. .	3	. .	7035	. .	162	. .	167	166	145	180	130	137	. .	180	. .	. .	168	159
	. .	2	. .	7038	. .	469	. .	483	. .	. .	. .	428	455	. .	488	. .	. .	496	470
	. .	5	. .	7040	056	060	067	060	. .	065	061	057	068	. .	046	. .	. .	041	058
Awv	. .	3	. .	7090	. .	. .	. .	. .	. .	. .	661	635	674	. .	616	. .	. .	638	645
	. .	6	. .	7122	. .	. .	. .	. .	. .	. .	513	468	497	. .	535	. .	. .	444	491
Awv	. .	1	. .	7147	. .	. .	. .	. .	. .	. .	921	924	964	. .	958	. .	. .	. .	942
	. .	7	. .	7148	. .	. .	. .	. .	. .	. .	457	417	416	. .	. .	. .	. .	417	427
	. .	7	. .	7168	. .	. .	. .	. .	. .	. .	178	181	209	. .	242	. .	. .	143	191
Awv	. .	d, 3	. .	7176	. .	. .	. .	. .	. .	. .	370	332	366	371	361	. .	. .	292	347
	. .	17	. .	7184	. .	800*	. .	. .	. .	. .	788	798	763	804	778	. .	. .	757	781
Awv	. .	d, 6	. .	7186	. .	. .	. .	. .	. .	. .	581	549	567	550	566	. .	. .	497	552
Awv	. .	d, 3	. .	7193	. .	. .	. .	. .	. .	. .	. .	916	. .	913	. .	. .	. .	935	921
Awv	. .	d, 10	. .	7200	. .	. .	. .	. .	. .	. .	765	742	759	. .	767	. .	. .	734	753
Awv	. .	10	. .	7201	. .	. .	. .	. .	. .	. .	468	454	504	. .	486	. .	. .	434	468
Awv	. .	6	. .	7216	. .	806*	. .	. .	. .	. .	827	. .	782	. .	834	. .	. .	. .	812
Awv	. .	8	. .	7223	. .	930*	. .	. .	. .	. .	927	. .	919	942	930	. .	. .	. .	930
	. .	6	. .	7227	. .	753*	. .	. .	. .	. .	736	. .	775	. .	797	. .	. .	. .	765
Awv	. .	3	. .	7232	. .	. .	. .	. .	. .	. .	489	. .	510	. .	529	. .	. .	. .	509
Awv	. .	8	. .	7233	. .	179*	. .	. .	. .	. .	184	. .	195†	. .	124	. .	. .	. .	171
Awv	. .	d, 4	. .	7240	. .	981*	. .	. .	. .	. .	980	. .	997	957	946	. .	. .	. .	972
Awv	. .	d, 15	. .	7243	. .	. .	. .	. .	. .	. .	911	. .	903	905	898	. .	. .	. .	904
Awv	. .	4	. .	7247	. .	. .	. .	. .	. .	. .	440	. .	. .	. .	481	. .	. .	. .	461
Awv	. .	8	. .	7264	. .	. .	. .	. .	. .	. .	836	. .	870	. .	848	. .	. .	. .	851
Awv	. .	8	. .	7265	. .	. .	. .	. .	. .	. .	750	. .	850	. .	888	. .	. .	. .	833
Awv	. .	d, 3	. .	7270	. .	. .	. .	. .	. .	. .	188	. .	. .	. .	221	. .	. .	. .	205
	. .	8	. .	7273	. .	. .	. .	. .	. .	. .	270	. .	239	247	267	. .	. .	. .	256
	. .	. .	. .	7275	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	675	. .	. .	. .	675
Awv	. .	6	. .	7287	. .	. .	. .	. .	. .	. .	684	. .	697	. .	686	. .	. .	. .	689
	. .	10	. .	7290	. .	. .	. .	. .	. .	. .	719	. .	735	728	675	. .	. .	. .	714
	. .	d, 4	. .	7300	. .	. .	. .	. .	. .	. .	961	. .	132	075	. .	. .	. .	. .	056
Awv	. .	7	. .	7304	. .	. .	. .	. .	. .	. .	476	. .	517	465	442	. .	. .	. .	475
Awv	. .	5	. .	7318	. .	. .	. .	. .	. .	. .	778	. .	777	802	916	. .	. .	. .	818
	. .	2	. .	7321	. .	. .	. .	. .	. .	. .	058	. .	. .	050	060	. .	. .	. .	056
	. .	2	. .	7331	. .	. .	. .	. .	. .	. .	195	. .	215	. .	209	. .	. .	. .	206
	. .	2	. .	7335	. .	. .	. .	. .	. .	. .	. .	. .	648	. .	659	. .	. .	. .	654
	. .	. .	. .	7389	. .	. .	. .	. .	. .	. .	. .	. .	. .	719	672	. .	. .	. .	696

---

* From 4823.690 and 4824.325.

† The lines 4823, 4824, and 4860 were observed in the third spectrum and used as standards.

	Intensity in Arc	Intensity in Sun.	Kind of Standard		St	St	u ⊙	p ⊙	q ⊙	o ⊙	C ⊙	R ⊙	h ⊙	i ⊙	C′ ⊙	i′ ⊙	Pl 22 J c ⊙	Pl 23 J c ⊙	Mean ⊙
	. .	. .	. .	7409	. .	. .	. .	. .	. .	. .	. .	. .	. .	578	530	. .	. .	. .	554
	. .	6	. .	7446	. .	. .	. .	. .	. .	. .	. .	. .	057	042	014	. .	. .	. .	038
	. .	. .	. .	7462	. .	. .	. .	. .	. .	. .	. .	. .	. .	619	599	. .	. .	. .	609
	. .	6	. .	7495	. .	. .	. .	. .	. .	. .	. .	. .	371	335	348	. .	. .	. .	351
	. .	6	. .	7511	. .	. .	. .	. .	. .	. .	. .	. .	310	272	275	. .	. .	. .	286
	. .	. .	. .	7545	. .	. .	. .	. .	. .	. .	. .	. .	921	. .	. .	. .	. .	. .	921
Awv	. .	. .	. .	7594*	. .	. .	. .	. .	. .	. .	. .	. .	113	023	053	047	. .	. .	059
Awv	. .	10	. .	7621†	278	. .	. .	. .	. .	. .	. .	. .	272	279	278	279	. .	. .	277
Awv	. .	7	. .	7623	. .	. .	. .	. .	. .	. .	. .	. .	498	525	560	522	. .	. .	526
Awv	. .	7	. .	7624	. .	. .	. .	. .	. .	. .	. .	. .	837	812	820	903	. .	. .	853
Awv	. .	7	. .	7627	. .	. .	. .	. .	. .	. .	. .	. .	342	. .	244	111	. .	. .	232
Awv	. .	7	. .	7628	. .	. .	. .	. .	. .	. .	. .	. .	689	. .	570	496	. .	. .	585
Awv	. .	7	. .	7659	. .	. .	. .	. .	. .	. .	. .	. .	. .	643	666	666	. .	. .	658
Awv	. .	6	. .	7660	. .	. .	. .	. .	. .	. .	. .	. .	. .	772	781	781	. .	. .	778
Awv	. .	6	. .	7665	. .	. .	. .	. .	. .	. .	. .	. .	. .	296	307	191	. .	. .	265
Awv	. .	5	. .	7666	. .	. .	. .	. .	. .	. .	. .	. .	. .	256	291	171	. .	. .	239
Awv	. .	4	. .	7670	. .	. .	. .	. .	. .	. .	. .	. .	. .	006	995	977	. .	. .	993
Awv	. .	4	. .	7671	. .	. .	. .	. .	. .	. .	. .	. .	. .	007	999	977	. .	. .	994
Awv	. .	4	. .	7699	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	374	. .	. .	. .	374
	. .	2	. .	7714	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	686	. .	. .	. .	686

* Beginning of the head of A, outside edge.

† Single line between the head and tail of A.

Remarks, Critical and Otherwise.

In looking over this paper, the following thought occurred to me of a critical nature. First, it is to be noted that the observations have extended over ten years, and have many of them been made for other purposes than for the use here made of them. Hence the paper seems to lack unity of purpose, as many of the standards were added after the observations had begun, and do not appear in the earlier series. But it must be remembered that no good map of the spectrum existed at the time they were commenced, and I had no means of avoiding poor standards and selecting the best, such as I might do at present. To retain the old observations I was thus obliged to retain many poor standards. Again, for the method of coincidences only poor standards may exist in the limited region where the measurements were made.

The effect of all this is to make many gaps in the table. But many of the gaps also come from other causes which could not be avoided.

The series of metallic plates was primarily made for measuring the spectra of metals. It is unfortunate for the present use that they nearly all begun and ended at the same place, overlapping very little. However, I have nearly always measured one or more plates to fill in the gap, and the coincidence of the values on these with the others shows that no error has been committed. Indeed, the accuracy with which the parts of this patchwork table fit into one another gives more confidence to me than if it had been made up of regular parts designed for their purpose.